GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SANTANA ATRIUM SENIOR APARTMENTS
100 N. WINCHESTER BOULEVARD
SANTA CLARA, SANTA CLARA COUNTY, CALIFORNIA

KA PROJECT NO. 042-15006
MARCH 26, 2015

Prepared for:

MR. ROYCE PATCH
USA PROPERTIES FUND, INC.
3200 DOUGLASS BOULEVARD, SUITE 200
ROSEVILLE, CALIFORNIA 95661

Prepared by:

KRAZAN & ASSOCIATES, INC.
GEOTECHNICAL ENGINEERING DIVISION
1061 SERPENTINE LANE, SUITE F
PLEASANTON, CALIFORNIA 94566
(925) 307-1160

March 26, 2015

KA Project No. 042-15006

Mr. Royce Patch
USA Properties Fund, Inc.
3200 Douglas Boulevard, Suite 200
Roseville, California 95661

RE: Geotechnical Engineering Investigation
Proposed Santana Atrium Senior Apartments
100 N. Winchester Boulevard
Santa Clara, Santa Clara County, California

Dear Mr. Patch:

In accordance with your request, we have completed a Geotechnical Engineering Investigation for the above-referenced site. The results of our investigation are presented in the attached report.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (925) 307-1160.

REGISTERED PROFESSIONAL ENGINEER
DAVID R. JAROSZ, II
NO. 2698
Expires June 30, 2016
GEOTECHNICAL
STATE OF CALIFORNIA

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

David R. Jarosz, II
Managing Engineer
RGE No. 2698/RCE No. 60185

DRJ:ht

TABLE OF CONTENTS

March 26, 2015 KA Project No. 042-15006

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SANTANA ATRIUM SENIOR APARTMENTS
100 N. WINCHESTER BOULEVARD
SANTA CLARA, SANTA CLARA COUNTY, CALIFORNIA

INTRODUCTION

This report presents the results of our Geotechnical Engineering Investigation for the proposed Santana Atrium Senior Apartments to be located at 100 N. Winchester Boulevard in Santa Clara, Santa Clara County, California. Discussions regarding site conditions are presented herein, together with conclusions and recommendations pertaining to site preparation, Engineered Fill, utility trench backfill, drainage and landscaping, foundations, concrete floor slabs and exterior flatwork, retaining walls, soil cement reactivity, and pavement design.

A site plan showing the approximate boring locations is presented following the text of this report. A description of the field investigation, boring logs, and the boring log legend are presented in Appendix A. Appendix A also contains a description of the laboratory testing phase of this study, along with the laboratory test results. Appendices B and C contain guides to earthwork and pavement specifications. When conflicts in the text of the report occur with the general specifications in the appendices, the recommendations in the text of the report have precedence.

PURPOSE AND SCOPE

This investigation was conducted to evaluate the soil and groundwater conditions at the site, to make geotechnical engineering recommendations for use in design of specific construction elements, and to provide criteria for site preparation and Engineered Fill construction.

Our scope of services included the following:

- A site reconnaissance by a member of our engineering staff to evaluate the surface conditions at the project site.
- A field investigation consisting of drilling 7 borings to depths ranging from approximately 10 to 44 feet for evaluation of the subsurface conditions at the project site.
- Performing laboratory tests on representative soil samples obtained from the borings to evaluate the physical and index properties of the subsurface soils.

- Evaluation of the data obtained from the investigation and an engineering analysis to provide recommendations for use in the project design and preparation of construction specifications.
- Preparation of this report summarizing the results, conclusions, recommendations, and findings of our investigation.

PROPOSED CONSTRUCTION

We understand that design of the proposed development is currently underway; structural load information and other final details pertaining the structures are unavailable. On a preliminary basis, it is understood that the planned development will include the construction of 90 multi-family residential units. It is anticipated the building will be a three-story structure. The building is planned to be a wood-framed structure utilizing concrete slab-on-grade or a post-tension foundation system. Foundation loads are anticipated to be light to moderate. On-site paved areas and landscaping are also planned for the development of the project.

In the event, these structural or grading details are inconsistent with the final design criteria, the Soils Engineer should be notified so that we may update this writing as applicable.

SITE LOCATION, SITE HISTORY AND SITE DESCRIPTION

The site is rectangular in shape and encompasses approximately 1.86 acres. The site is identified by Assessor's Parcel No. (APN) 303-16-073. The site is located approximately 340 feet south of Pruner Ridge Avenue just west of Winchester Boulevard in the City of Santa Clara, Santa Clara County, California. Commercial developments are located north and east of the site. The remainder of the site is predominately surrounded by residential developments.

Site history was obtained by reviewing historical aerial photographs taken in 1937, 1948, 1950, 1956, 1968, 1974, 1982, 1993, 1998, 2005 and 2012. Review of the 1937 aerial photograph indicates that the eastern portion of the site appears to be occupied by a small structure adjacent to Winchester Boulevard. The remainder of the site appears to be utilized for agricultural purposes and occupied by an orchard.

Review of the 1948 aerial photograph indicates that the project site conditions appeared to be relatively similar to that noted in the 1937 aerial photograph.

Review of the 1950 and 1956 aerial photographs indicate that the project site conditions appeared to be relatively similar to that noted in the 1948 aerial photograph with the addition of residential and commercial developments surrounding the site.

Review of the 1968 aerial photograph indicates that the project site is occupied by a partially completed commercial structure.

Review of the 1974 aerial photograph indicates that the project site conditions appeared to be relatively similar to that noted in the 1968 aerial photograph, except the on-site office building appears to be completed and the parking area in the western portion of the site appears to be paved.

Review of the 1982, 1993, 1998, 2005 and 2012 aerial photographs indicate that the project site conditions appeared to be relatively similar to that noted in the 1974 aerial photograph with additional commercial and residential developments surrounding the site.

Presently, the site is occupied by one three-story commercial office building reported to contain approximately 65,048 square feet. The remainder of the site is developed with paved parking and driveways. Several landscaped areas are located throughout the site. Buried utility lines are located along the edges of the site and extend into portions of the site. Portions of the site are covered by a sparse to moderate grass growth and the surface soils have a loose consistency. The site is relatively level with no major changes in grade.

GEOLOGIC SETTING

The project area is located just south of San Francisco Bay and east of the Santa Cruz Mountains within the northern portion of the Coast Ranges Geomorphic Province of California. The Coast Ranges generally consist of an alternating series of parallel mountains and valleys located adjacent to the Pacific Coast. The bedrock units that form the range have been disrupted by intense folding, faulting, and crushing that occurred when the range was formed by the processes of plate tectonics. During the Jurassic and Cretaceous Periods (about 150 to 80 million years ago), the Pacific Oceanic Plate, which was progressively moving towards the east, collided with the North American Continental Plate, which was moving toward the west. This collision caused the less rigid Pacific Oceanic Plate to be subducted beneath the North American Continental Plate. The colliding motion of the two plates caused portions of the Pacific Oceanic Crust and overlying marine sediments to be piled onto the North American Continental Plate along the west coast of California. The resulting chaotic jumble of bedrock units scraped off onto the North American Plate, is known as the "Franciscan Assemblage" and comprises a large portion of the Coast Range Province. Subsequent development of a series of northwest-trending fault zones has further contributed to the deformation of the Coast Range.

The near-surface deposits in the vicinity of the subject site are indicated to be comprised of Holocene alluvial fan deposits and alluvial fan levee deposits consisting of sands, silt, and clays derived from erosion of local mountain ranges. Deposits encountered on the subject site during exploratory drilling are discussed in detail in this report.

Seven major faults are located near the site: The Monte Vista–Shannon fault, the San Andreas fault, the Hayward fault, the Calaveras fault, the Zayante-Vergeles fault, the San Gregorio fault, and the Mount Diablo Thrust fault. The Monte Vista–Shannon fault and the San Andreas fault are located approximately 5 and 9 miles west of the site, respectively. The San Andreas fault was the source of the 1906 San Francisco Earthquake. The Hayward fault is located approximately 10 miles east of the site. The Hayward fault is considered capable of producing an earthquake event of magnitude 7.0. The last recorded movement of the Hayward fault was in 1868. The Calaveras fault is located approximately 11 miles east of the site and is considered capable of producing an earthquake of magnitude of 6.9. The Zaynte-Vergeles fault is approximately 16 miles north of the site and is considered capable of producing an earthquake of magnitude 7.0. The San Gregorio fault and Mount Diablo Thrust are located approximately 23 miles west and 28 miles east of the site, respectively, and are also considered capable of producing large earthquakes. Although the site is in close proximity to several faults, the site is not within a State of California Earthquake Fault Zone or Special Study Zone for faulting.

The probability of one or more earthquakes of magnitude 6.7 or higher occurring in the San Francisco Bay Area within a 30-year period of time was evaluated by the U.S. Geological Survey (USGS) Working Group on California Earthquake Probabilities on a periodic basis. The result of tbe 2008 evaluation indicated a 63 percent likelihood that such an earthquake event will occur in the Bay Area between 2007 and 2036 (USGS 2008). The faults with the greater probability of a magnitude 6.7 or higher earthquake are the Hayward fault at 31 percent and the San Andreas fault at 21 percent.

The Alquist-Priolo Earthquake Fault Zoning Act went into affect in March, 1973. Since that time, the act has been amended 11 times (Hart, 2007). The purpose of the Act, as provided in CGS Special Publication 42 (SP 42), is to prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture." The act was renamed the Alquist-Priolo Earthquake Fault Zoning Act in 1994, and at that time, the originally designated "Special Studies Zones" was renamed the "Earthquake Fault Zones."

The area of the subject site is not included on an Earthquake Fault Zones Map. At this time there is no Earthquake Fault Zones Map for the San Jose West Quadrangle. In addition, the site is not within a Fault-Rupture Hazard Zone. The nearest zoned faults are portions of the San Andreas and Hayward faults located more 9 miles west and 10 miles east of the subject site, respectively.

In 1990, the California State Legislature passed the Seismic Hazard Mapping Act to protect public safety from the effects of strong shaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes. The Act requires that the State Geologist delineate various seismic hazards zones on Seismic Hazards Zones Maps. Specifically, the maps identify areas where soil liquefaction and earthquake-induced landslides are most likely to occur. A site-specific geotechnical evaluation is required prior to permitting most urban developments within the mapped zones. The Act also requires sellers of real property within the zones to disclose this fact to potential buyers. The area of the subject site is located within the bounds of the hazard zone associated with liquefaction potential and is outside of tbe zones associated with landslide potential, on the Seismic Hazards Zones San Jose West Quadrangle, dated, February 7, 2002. In addition, the site is included on the U.S. Geological Survey map entitled "Liquefaction Susceptibility, Central San Francisco Bay Region, California" (U.S. Geological Survey Open-File Report 2006-1037), dated 2006. The site is located within an area identified as a moderate susceptibility to liquefaction.

FIELD AND LABORATORY INVESTIGATIONS

Subsurface soil conditions were explored by drilling 7 borings depths ranging from approximately 10 to 44 feet below existing site grade, using a truck-mounted drill rig. In addition, 2 bulk subgrade samples were obtained from the site for laboratory R-value testing. The approximate boring and bulk sample locations are shown on the site plan. During drilling operations, penetration tests were performed at regular intervals to evaluate the soil consistency and to obtain information regarding the engineering properties of the subsoils. Soil samples were retained for laboratory testing. The soils encountered were continuously examined and visually classified in accordance with the Unified Soil Classification System. A more detailed description of the field investigation is presented in Appendix A.

Laboratory tests were performed on selected soil samples to evaluate their physical characteristics and engineering properties. The laboratory testing program was formulated with emphasis on the evaluation of natural moisture, density, gradation, shear strength, unconfined compression, consolidation potential, expansion potential, atterberg limits, stability (R-value) test, and moisture-density relationships of the materials encountered. In addition, chemical tests were performed to evaluate the corrosivity of the soils to buried concrete and metal. Details of the laboratory test program and results of the laboratory tests are summarized in Appendix A. This information, along with the field observations, was used to prepare the final boring logs in Appendix A.

SOIL PROFILE AND SUBSURFACE CONDITIONS

Based on our findings, the subsurface conditions encountered appear typical of those found in the geologic region of the site. In general, portions of the site were covered with a pavement section consisting of approximately 4 inches of asphaltic concrete underlain by 4 inches of aggregate base. Within areas not covered by pavement, the upper soils consisted of approximately 6 to 12 inches of very loose/soft sandy clay, silty clay or gravelly silty sand. These soils are disturbed, have low strength characteristics and are highly compressible when saturated.

Beneath the pavement section and loose surface soil, approximately 2½ to 6½ feet of fill material was encountered. The fill material predominately consisted of silty clay, sandy clay or gravelly silty sand. The thickness and extent of fill material was determined based on limited test borings and visual observation. Thicker fill may be present at the site. Limited testing was performed on the fill soil during the time of our field and laboratory investigations. This limited testing indicates that the fill soils had varying strength characteristics ranging from loosely placed to compacted.

Below the pavement section, loose surface soils and fill material, approximately 3 to 4 feet of very stiff to hard sandy clay or silty clay were encountered. Field and laboratory tests suggest that these soils are moderately strong, slightly compressible and have a moderate potential for expansion. Penetration resistance ranged from 23 to 41 blows per foot. Dry densities ranged from 93 to 123 pcf. Representative soil samples consolidated approximately 1½ percent under a 2 ksf load when saturated. A representative soil sample had an angle of internal friction of 34 degrees. Representative samples of the clayey soils had an expansion indices of 53 and 62.

Below 5 to 10 feet, alternating layers of predominately medium dense/very stiff to dense/hard silty sand, sandy silt, silty sand/sandy silt, clayey sand, sandy clay, sandy clayey silt or silty clay were encountered. Penetration resistance ranged from 21 to 41 blows per foot. Dry densities ranged from 110 to 131 pcf. Representative soil samples consolidated approximately 1 to 2½ percent under a 2 ksf load when saturated. These soils had similar strength characteristics as the upper soils and extended to the termination depth of our borings.

For additional information about the soils encountered, please refer to the logs of borings in Appendix A.

GROUNDWATER

Test boring locations were checked for the presence of groundwater during and immediately following the drilling operations. Free groundwater was not encountered within a depth of 44 feet during our subsurface investigation. However, historical groundwater has been as shallow as 20 feet within the project site vicinity.

It should be recognized that water table elevations may fluctuate with time, being dependent upon seasonal precipitation, irrigation, land use and climatic conditions, as well as other factors. Therefore, water level observations at the time of the field investigation may vary from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

SOIL LIQUEFACTION

Soil liquefaction is a state of soil particles suspension caused by a complete loss of strength when the effective stress drops to zero. Liquefaction normally occurs under saturated conditions in soils such as sand in which the strength is purely frictional. However, liquefaction has occurred in soils other than clean sand. Liquefaction usually occurs under vibratory conditions such as those induced by seismic event.

To evaluate the liquefaction potential of the site, the following items were evaluated:

1) Soil type

2) Groundwater depth

3) Relative density

4) Initial confining pressure

5) Intensity and duration of groundshaking

The predominant soils within the project site consist of alternating layers of silty clay, sandy clay, clayey sand, clayey silt, silty sand, gravel and sand. Free groundwater was not encountered within a depth of 44 feet below existing site grade during our exploratory drilling. However, historically, groundwater has been as shallow as 20 feet within the project site vicinity.

The potential for soil liquefaction during a seismic event was evaluated using the LIQUEFYPRO computer program (version 5) developed by CivilTech Software. For the analysis, a maximum earthquake magnitude of 8.0 was used. A peak horizontal ground surface acceleration of 0.5g was considered conservative and appropriate for the liquefaction analysis. An estimated high groundwater depth of 20 feet was used for our analysis. The computer analysis indicates that soils above a depth of

20 feet are non-liquefiable due to the absence of groundwater. The soils below a depth of 20 feet have a slight potential for liquefaction under seismic shaking due to predominately loose silty sand, firm sandy clay soils, and the anticipated moderate seismicity in the region.

The analysis also indicates that the estimated total seismic induced settlement is less than ¾ inch. Differential settlement caused by a seismic event is estimated to be less than ¼ inch. The anticipated differential settlement is estimated over the width of the structure.

SEISMIC SETTLEMENT

One of the most common phenomena during seismic shaking accompanying any earthquake is the settlement of loose unconsolidated soils. Based on site subsurface conditions and the moderate to high seismicity of the region, any loose fill material at the site could be vulnerable to this potential hazard. However, this hazard can be mitigated by following the design and construction recommendations of our Geotechnical Engineering Investigation (over-excavation and rework of the loose soils and/or fill). Based on the moderate penetration resistance measured, the native deposits underlying the site do not appear to be subject to significant seismic settlement.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of our field and laboratory investigations, along with previous geotechnical experience in the project area, the following is a summary of our evaluations, conclusions, and recommendations.

Administrative Summary

In brief, the suhject site and soil conditions, with the exception of the fill material, moderate shrink/swell potential of the upper clayey soils, potential seismic settlement and existing development appear to be conducive to the development of the project. Approximately 2½ to 6½ feet of fill material was encountered within the borings drilled across the site. The fill material predominately consisted of silty clay, sandy clay and gravelly silty sand. The thickness and extent of fill material was determined based on limited test borings and visual observations. Thicker fill may be present at the site. Limited testing was performed on the fill soil during the time of our field and laboratory investigations. The limited testing indicates that the fill material ranged from loosely placed to compacted. Therefore, it is recommended that the fill soil be excavated and stockpiled so that the native soils can be properly prepared. The fill material that does not contain clay will be suitable for reuse as non-expansive Engineered Fill provided it is cleansed of excessive organics and debris. The clayey fill soils will not be suitable for reuse as non-expansive Engineered Fill. However, the clayey fill material will be suitable for reuse as General Engineered Fill, provided it is cleansed of excessive organics and debris and moisture-conditioned to a minimum of 2 percent above optimum moisture-content. The fill material should be compacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557. Prior to fill placement Krazan & Associates, Inc. should inspect the bottom of the excavation to verify no additional removal will be required.

The on-site clayey soils appear to have a moderate shrink/swell potential. To reduce potential soil movement related to shrink/swell of the clayey soils, it is recommended that slab-on-grade and exterior flatwork areas be supported by at least 24 inches of non-expansive Engineered Fill. The fill material should be a well-graded silty sand or sandy silt soil. A clean sand or very sandy soil is not acceptable for this purpose. A sandy soil will allow the surface water to drain into the expansive soils below, which may result in soil swelling. The replacement soils and/or upper 24 inches of Imported Fill soils should meet the specifications as described under the subheading Engineered Fill. The replacement soils should extend 5 feet beyond the perimeter of slab-on-grade areas. The non-expansive replacement soils should be compacted to at least 90 percent of relative compaction based on ASTM Test Method D1557. The exposed native soils in the excavation should not be allowed to dry out and should be kept continually moist, prior to backfilling. In addition, it is recommended that slab-on-grade, continuous footings and slabs be nominally reinforced to reduce cracking and vertical off-set.

As an alternative to the use of non-expansive soils, the upper 24 inches of soil supporting the slab-on-grade and exterior flatwork areas can consist of lime-treated clayey soils. The lime-treated soils should be recompacted to a minimum of 90 percent of maximum density. Preliminary application rate of lime should be 5 percent by dry weight. The lime material should be calcium oxide, commonly known as quick-lime. The clayey soils should be above optimum moisture during the mixing operations. In lieu of supporting the structure on non-expansive Engineered Fill or lime-treated material, the building can be supported on a post-tensioned slab system designed to withstand the movements associated with the on-site clayey soils.

The site is presently occupied by a commercial development. In addition, portions of the site are covered with concrete and asphaltic concrete pavement. Associated with these developments are buried structures that may extend throughout the project site. Demolition activities should include proper removal of any buried structures. Any buried structures including utilities or loosely backfilled excavations, encountered during construction should be properly removed and the resulting excavations backfilled. After demolition activities, it is recommended that these disturbed soils be removed and/or recompacted. This compaction effort should stabilize the upper soils and locate any unsuitable or pliant areas not found during our field investigation.

After completion of the recommended site preparation and over-excavation, the site should be suitable for shallow footing support. The proposed structure footings may be designed utilizing an allowable bearing pressure of 2,500 psf for dead-plus-live loads. Footings should have a minimum embedment of 18 inches. As an alternative, the proposed structure may be supported by a post-tensioned or structural slab. Utilization of a post-tensioned/structural slab designed utilizing the parameters provided in the post-tension section of this report will eliminate the requirement for 24 inches of non-expansive or lime-treated Engineered Fill below concrete slabs-on-grade. However, the previously recommended densification of the upper native soils and fill material at the site should still be performed. Recommendations for a structural slab system are also provided herein.

Groundwater Influence on Structures/Construction

During our field investigation, groundwater was not encountered. However, historic groundwater levels are anticipated to be as shallow as 20 feet below existing site grade. Based on the anticipated depth of construction, groundwater is not anticipated to impact the proposed construction. Therefore, dewatering and/or waterproofing may be required. If groundwater is encountered, our firm should be consulted prior to dewatering the site. Installation of a standpipe piezometer is suggested prior to construction. The Contractor should refer to the soil boring logs in Appendix A for available information regarding groundwater levels at specific locations.

In addition to the groundwater level, if earthwork is performed during or soon after periods of precipitation, the subgrade soils may become saturated, pump, or not respond to densification techniques. Typical remedial measures include discing and aerating the soil during dry weather; mixing the soil with dryer materials; removing and replacing the soil with an approved fill material; or mixing the soil with an approved lime or cement product. Our firm should be consulted prior to implementing remedial measures to observe the unstable subgrade conditions and provide appropriate recommendations.

Site Preparation

General site clearing should include removal of vegetation; existing utilities; structures including foundations; basement walls and floors; existing stockpiled soil; trees and associated root systems; rubble; rubbish; and any loose and/or saturated materials. Site stripping should extend to a minimum depth of 2 to 4 inches, or until all organics in excess of 3 percent by volume are removed. Deeper stripping may be required in localized areas. These materials will not be suitable for reuse as Engineered Fill. However, stripped topsoil may be stockpiled and reused in landscape or non-structural areas.

Approximately 2½ to 6½ feet of fill material was encountered within the borings drilled across the site. The fill material predominately consisted of silty clay, sandy clay, gravelly silty sand, aggregate base and asphaltic concrete. The thickness and extent of fill material was determined based on limited test borings and visual observations. Thicker fill may be present at the site. Limited testing was performed on the fill soil during the time of our field and laboratory investigations. The limited testing indicates that the fill material ranged from loosely placed to compacted. Therefore, it is recommended that the fill soil be excavated and stockpiled so that the native soils can be properly prepared. The fill material that does not contain clay will be suitable for reuse as non-expansive Engineered Fill provided it is cleansed of excessive organics and debris. The clayey fill soils will not be suitable for reuse as non-expansive Engineered Fill. However, the clayey fill material will be suitable for reuse as General Engineered Fill, provided it is cleansed of excessive organics and debris and moisture-conditioned to a minimum of 2 percent above optimum moisture-content. The fill material should be compacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557. Prior to fill placement Krazan & Associates, Inc. should inspect the bottom of the excavation to verify no additional removal will be required.

The site is presently occupied by a commercial building and is presently utilized as a commercial development. Associated with this development are buried structures such as utility lines and possible water wells that may extend into the project site. Any buried structures, such as utilities or loosely backfilled excavations, encountered during construction should be properly removed and the resulting excavations backfilled. After demolition activities, it is recommended that these disturbed soils be removed and/or recompacted. Excavations, depressions, or soft and pliant areas extending below planned, finished subgrade levels should be cleaned to firm, undisturbed soil and backfilled with Engineered Fill. In general, any septic tanks, debris pits, cesspools, or similar structures should be entirely removed. Water wells should be abandoned in accordance with county standards. Concrete footings should be removed to an equivalent depth of at least 3 feet below proposed footing elevations or as recommended by the Soils Engineer. Any other buried structures should be removed in accordance with the recommendations of the Soils Engineer. The resulting excavations should be backfilled with Engineered Fill.

Following stripping, fill removal operations, demolition activities, and prior to fill placement, the exposed subgrade in building, pavement, and exterior flatwork areas should be excavated/scarified to a depth of at least 12 inches, worked until uniform and free from large clods, moisture-conditioned to a minimum of 2 percent above optimum moisture content, and recompacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557. This compaction effort should stabilize the surface soils and locate any unsuitable or pliant areas not found during our field investigation.

It is recommended that the upper 24 inches of soil within proposed conventional slab-on-grade and exterior flatwork areas consist of non-expansive Engineered Fill or lime-treated Engineered Fill. The fill placement serves two functions: 1) it provides a uniform amount of soil which will more evenly distribute the soil pressures and 2) it reduces moisture content fluctuation in the clayey material beneath the building area. The non-expansive fill material should be a well-graded silty sand or sandy silt soil. A clean sand or very sandy soil is not acceptable for this purpose. A sandy soil will allow the surface water to drain into the expansive clayey soil below, which may result in soil swelling. Imported Fill should be approved hy the Soils Engineer prior to placement. The fill should be placed as specified as Engineered Fill. In addition, concrete slabs and flatwork should be nominally reinforced to reduce cracking and vertical off-sets.

As indicated previously, fill material is located across the site. It is recommended that any uncertified fill material encountered within pavement areas, be removed and/or recompacted. The fill material should be moisture-conditioned to a minimum of 2 percent above optimum moisture and recompacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557. As an alternative, the Owner may elect not to recompact the existing fill within paved areas. However, the Owner should be aware that the paved areas may settle which may require annual maintenance. At a minimum, it is recommended that the upper 12 inches of subgrade soil be moisture-conditioned to a minimum of 2 percent above optimum moisture content and recompacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557.

The upper soils, during wet winter months, become very moist due to the absorptive characteristics of the soil. Earthwork operations performed during winter months may encounter very moist unstable soils, which may require removal to grade a stable building foundation. Project site winterization consisting of placement of aggregate base and protecting exposed soils during the construction phase should be performed.

A representative of our firm should be present during all site clearing and grading operations to test and observe earthwork construction. This testing and observation is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction and stability of the material. The Soils Engineer may reject any material that does not meet compaction and stability requirements. Further recommendations of this report are predicated upon the assumption that earthwork construction will conform to recommendations set forth in this section and the Engineered Fill section.

Engineered Fill

The on-site upper native soils and fill material are predominately silty sands, clayey sands, silty clays and sandy clays. These soils contained varying amounts of gravel. The clayey soils will not be suitable for reuse as non-expansive Engineered Fill. The clayey soils will be suitable for reuse for fill placement within the upper 24 inches of conventional slab-on-grade and exterior flatwork areas, provided they are lime-treated. The preliminary application rate of lime should be 5 percent by dry weight. The lime material should be calcium oxide, commonly known as quick-lime. The clayey soils should be at or near optimum moisture-condition during mixing operations. Additional testing is recommended to determine the appropriate application rate of lime prior to placement. These clayey soils will be suitable for reuse as General Engineered Fill provided they are cleansed of excessive organics, debris, and moisture-conditioned to at least 2 percent above optimum moisture. It is recommended that additional testing be performed on the on-site soils and fill material to evaluate tbe physical and index properties prior to reuse as Engineered Fill. The asphaltic concrete will not be suitable for reuse as Engineered Fill within the proposed building area. The asphaltic concrete may be used in pavement areas provided it is broken into fragments smaller than 4 inches in maximum dimension.

The preferred materials specified for Engineered Fill are suitable for most applications with the exception of exposure to erosion. Project site winterization and protection of exposed soils during the construction phase should be the sole responsibility of the Contractor, since he has complete control of the project site at that time.

Imported non-expansive Fill should consist of a well-graded, slightly cohesive, fine silty sand or sandy silt soil, with relatively impervious characteristics when compacted. This material should be approved by the Soils Engineer prior to use and should typically possess the following characteristics:

Percent Passing No. 200 Sieve	20 to 50
Plasticity Index	10 maximum
UBC Standard 29-2 Expansion Index	15 maximum

Fill soils should be placed in lifts approximately 6 inches thick, moisture-conditioned to a minimum of 2 percent above optimum moisture content, and compacted to achieve at least 90 percent of maximum density as determined by ASTM D1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable.

Drainage and Landscaping

The ground surface should slope away from building pad and pavement areas toward appropriate drop inlets or other surface drainage devices. In accordance with Section 1804 of the 2013 California Building Code, it is recommended that the ground surface adjacent to foundations be sloped a minimum of 5 percent for a minimum distance of 10 feet away from structures, or to an approved alternative means of drainage conveyance. Swales used for conveyance of drainage and located within 10 feet of foundations should be sloped a minimum of 2 percent. Impervious surfaces, such as pavement and exterior concrete flatwork, within 10 feet of building foundations should be sloped a minimum of 1 percent away from the structure. Drainage gradients should be maintained to carry all surface water to collection facilities and off-site. These grades should be maintained for the life of the project.

Slots or weep holes should be placed in drop inlets or other surface drainage devices in pavement areas to allow free drainage of adjoining base course materials. Cutoff walls should be installed at pavement edges adjacent to vehicular traffic areas these walls should extend to a minimum depth of 12 inches below pavement subgrades to limit the amount of seepage water that can infiltrate the pavements. Where cutoff walls are undesirable subgrade drains can be constructed to transport excess water away from planters to drainage interceptors. If cutoff walls can be successfully used at the site, construction of subgrade drains is considered unnecessary.

Utility Trench Backfill

Utility trenches should be excavated according to accepted engineering practice following OSHA (Occupational Safety and Health Administration) standards by a Contractor experienced in such work. The responsibility for the safety of open trenches should be borne by the Contractor. Traffic and vibration adjacent to trench walls should be reduced; cyclic wetting and drying of excavation side slopes should be avoided. Depending upon the location and depth of some utility trenches, groundwater flow into open excavations could be experienced; especially during or following periods of precipitation.

Sandy and gravelly soil conditions were encountered at the site. These cohesionless soils have a tendency to cave in trench wall excavations. Shoring or sloping back trench sidewalls may be required within these sandy and gravelly soils.

Utility trench backfill placed in or adjacent to buildings and exterior slabs should be compacted to at least 90 percent of maximum density based on ASTM Test Method D1557. The utility trench backfill placed in pavement areas should be compacted to at least 90 percent of maximum density based on ASTM Test Method D1557. Pipe bedding should be in accordance with pipe manufacturer's recommendations.

The Contractor is responsible for removing all water-sensitive soils from the trench regardless of the backfill location and compaction requirements. The Contractor should use appropriate equipment and methods to avoid damage to the utilities and/or structures during fill placement and compaction.

Foundations - Conventional

After completion of the recommended site preparation and over-excavation, the site should be suitable for shallow footing support. The proposed structures may be supported on a shallow foundation system bearing on undisturbed native soils or Engineered Fill. Spread and continuous footings can be designed for the following maximum allowable soil bearing pressures:

Load	Allowable Loading
Dead Load Only	1,875 psf
Dead-Plus-Live Load	2,500 psf
Total Load, Including Wind or Seismic Loads	3,325 psf

The footings should have a minimum embedment depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Footings should have a minimum width of 12 inches, regardless of load.

The footing excavations should not be allowed to dry out any time prior to pouring concrete. It is recommended that footings be reinforced by at least one No. 4 reinforcing bar in both top and bottom.

Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.3 acting between the base of foundations and the supporting subgrade. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 250 pounds per cubic foot acting against the appropriate vertical footing faces. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. A ⅓ increase in the value above may be used for short duration, wind, or seismic loads. All of the above earth pressures are unfactored and are, therefore, not inclusive of factors of safety.

Foundations - Post-Tension or Structural Slab

The building may be supported on a post-tension slab or structural slab/foundation system. A structural slab system will help reduce structural damage caused by the potential soil movement of the clayey soils and potential seismic settlement. In addition, utilization of a post-tensioned slab will eliminate the requirement for 24 inches of non-expansive or lime-treated Engineered Fill below slab-on-grade. However, the previously recommended densification of the upper native soils and fill material at the site should still be performed.

The thickness of the slab-on-grade and locations and sizing of stiffening beams (if used) should be determined by the structural consultant during a subsequent structural analysis, which incorporates our design recommendations, including a deepened perimeter or edge section. Post-tensioned slab-on-grade foundations should be structurally designed to resist or distribute the stresses that are anticipated to develop as the result of supporting soil movement. The following preliminary parameters are recommended for use in the structural design of the post-tensioned slab-on-grade foundations in accordance with *Design of Post-Tensioned Slabs-on-Ground*, 3rd Edition, by the Post-Tensioning Institute. In addition, the computer software program Volflo 1.5, by Geostructural Tool Kit, Inc. was also utilized in the analyses. A preliminary allowable bearing pressure of 2,000 pounds per square foot due to dead plus live loads may be considered in design of the slab. The recommended edge moisture variation (e_m) and differential swell (y_m) values for use in preliminary design of post-tensioned slabs are as follows:

Edge Moisture Variation Distance:	Estimated Differential Swell:
Center lift, e_m = 9 feet	Center lift, y_m = 1⅛ inch
Edge lift, e_m = 4.8 feet	Edge lift, y_m = 1¾ inch

To aid in reducing the potential for differential soil movement associated with shrinkage and swelling of the fine-grained soils due to changes in moisture contents with changing seasons and landscaping, we recommend that the exterior edge of the slab be deepened to provide a moisture cut-off around the perimeter of the building. The deepened edge should extend at least 12 inches below the top of the pad grade, where the top of pad grade is defined as the grade beneath the bottom of the capillary moisture break gravel course or the adjacent exterior subgrade, whichever is deeper.

In addition, the slab should be designed to withstand a potential total and differential seismic settlement of ¾ and ½ inch, respectively. The differential settlement is estimated over a distance of 100 feet.

Slabs adjacent to landscape areas may be subject to additional distress due to increased soil moisture level fluctuations from flowerbed watering, as well as drying from tree root moisture removal. Therefore, we recommend that property owners be notified of the potential for soil movement and resulting slab distress which may occur in these instances of landscape neglect. In addition, property owners should be instructed to maintain consistent moisture levels and avoid extreme fluctuations in any flowerbeds adjacent to structures, and to avoid planting trees with invasive root systems within 10 feet of the structures.

The thickness of the slab-on-grade and locations and sizing of stiffening beams (if used) should be determined by the project Structural Engineer. Post-tensioned concrete slabs designed to be of uniform thickness without interior stiffening beams should be designed in accordance with the procedures presented in *Design of Post-Tensioned Slabs-on-Ground.* Perimeter columns located outside of the main structure, such as those required for covered terraces or second floor areas projecting out beyond the building footprint should not be founded on isolated spread footings structurally separated from the slab foundation.

The post-tensioned slab-on-grade foundation system will not prevent the structure from undergoing vertical displacement as a result of shrinkage and swelling of the underlying expansive soils. However, the use of a post-tensioned slab-on-grade foundation system, as opposed to a conventionally reinforced non-structural slab-on-grade, will reduce the amount of objectionable slab cracks and vertical off-set of adjacent concrete panels. The use of post-tension reinforcement does not necessarily eliminate the development of bending stresses in the slab due to differential movement of the supporting soils. This type of slab essentially distributes the differential movement of the supported structure over a longer span through controlled bending of the slab.

Resistance to lateral displacement can be computed using an allowable friction factor of 0.3 acting between the base of foundations and the supporting subgrade. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 250 pounds per cubic foot acting against the appropriate vertical footing faces. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. A ⅓ increase in the above value may be used for short duration, wind, or seismic loads. All of the above earth pressures are unfactored and are, therefore, not inclusive of factors of safety.

Floor Slabs and Exterior Flatwork

To reduce post-construction soil movement beneath conventional slab-on-grade and exterior flatwork, it is recommended that mitigation measures be performed. For conventional slab-on-grade, it is recommended that the upper 24 inches of soil consist of non-expansive or lime-treated Engineered Fill.

Concrete slab-on-grade floors should be underlain by a water vapor retarder. The water vapor retarder should be installed in accordance with accepted engineering practice. The water vapor retarder should consist of a vapor retarder sheeting underlain by a minimum of 3 inches of compacted, clean, gravel of ¾-inch maximum size. To aid in concrete curing an optional 2 to 4 inches of granular fill may be placed on top of the vapor retarder. The granular fill should consist of damp clean sand with at least 10 to 30 percent of the sand passing the 100 sieve. The sand should be free of clay, silt, or organic material. Rock dust which is manufactured sand from rock crushing operations is typically suitable for the granular fill. This granular fill material should be compacted.

It is recommended that the concrete slabs be reinforced at a minimum with No. 3 reinforcing bars, placed at 18 inches on center in each direction within the slabs middle third, to reduce crack separation and possible vertical offset at the cracks. Thicker floor slabs with increased concrete strength and reinforcement should be designed wherever heavy concentrated loads, heavy equipment, or machinery is anticipated.

The exterior floors should be poured separately in order to act independently of the walls and foundation system. Exterior finish grades should be sloped a minimum of 2 percent away from all interior slab areas to preclude ponding of water adjacent to the structures. All fills required to bring the building pads to grade should be Engineered Fills.

Moisture within the structure may be derived from water vapors, which were transformed from the moisture within the soils. This moisture vapor can travel through the vapor membrane and penetrate the slab-on-grade. This moisture vapor penetration can affect floor coverings and produce mold and mildew in the structure. To reduce moisture vapor intrusion, it is recommended that a vapor retarder be installed. It is recommended that the utility trenches within the structure be compacted, as specified in our report, to reduce the transmission of moisture through the utility trench backfill. Special attention to the immediate drainage and irrigation around the building is recommended. Positive drainage should be established away from the structure and should be maintained throughout the life of the structure. Ponding of water should not be allowed adjacent to the structure. Over-irrigation within landscaped areas adjacent to the structure should not be performed. In addition, ventilation of the structure (i.e. ventilation fans) is recommended to reduce the accumulation of interior moisture.

Lateral Earth Pressures and Retaining Walls

Walls retaining horizontal backfill and capable of deflecting a minimum of 0.1 percent of its height at the top may be designed using an equivalent fluid active pressure of 50 pounds per square foot per foot of depth. Walls that are incapable of this deflection or walls that are fully constrained against deflection may be designed for an equivalent fluid at-rest pressure of 70 pounds per square foot per foot per depth. Expansive soils should not be used for backfill against walls. The wedge of non-expansive backfill material should extend from the bottom of each retaining wall outward and upward at a slope of 2:1 (horizontal to vertical) or flatter. The stated lateral earth pressures do not include the effects of hydrostatic water pressures generated by infiltrating surface water that may accumulate behind the retaining walls; or loads imposed by construction equipment, foundations, or roadways. All of the above earth pressures are unfactored and are, therefore, not inclusive of factors of safety.

During grading and backfilling operations adjacent to any walls, heavy equipment should not be allowed to operate within a lateral distance of 5 feet from the wall, or within a lateral distance equal to the wall height, whichever is greater, to avoid developing excessive lateral pressures. Within this zone, only hand operated equipment ("whackers," vibratory plates, or pneumatic compactors) should be used to compact the backfill soils.

Retaining and/or below grade walls should be drained with either perforated pipe encased in free-draining gravel or a prefabricated drainage system. The gravel zone should have a minimum width of 12 inches wide and should extend upward to within 12 inches of the top of the wall. The upper 12 inches of backfill should consist of native soils, concrete, asphaltic concrete or other suitable backfill to reduce surface drainage into the wall drain system. The aggregate should conform to Class 2 permeable materials graded in accordance with the CalTrans Standard Specifications (2010). Prefabricated drainage systems, such as Miradrain®, Enkadrain®, or an equivalent substitute, are acceptable alternatives in lieu of gravel provided they are installed in accordance with the manufacturer's recommendations. If a prefabricated drainage system is proposed, our firm should review the system for final acceptance prior to installation.

Drainage pipes should be placed with perforations down and should discharge in a non-erosive manner away from foundations and other improvements. The pipes should be placed no higher than 6 inches above the heel of the wall in the center line of the drainage blanket and should have a minimum diameter of 4 inches. Collector pipes may be either slotted or perforated. Slots should be no wider than ⅛ inch in diameter, while perforations should be no more than ¼ inch in diameter. If retaining walls are less than 6 feet in height, the perforated pipe may be omitted in lieu of weep holes on 4 feet maximum spacing. The weep holes should consist of 4-inch diameter holes (concrete walls) or unmortared head joints (masonry walls) and not be higher than 18 inches above the lowest adjacent grade. Two 8-inch square overlapping patches of geotextile fabric (conforming to the CalTrans Standard Specifications for "edge drains") should be affixed to the rear wall opening of each weep hole to retard soil piping.

R-Value Test Results and Pavement Design

Two subgrade soil samples were obtained from the project site for R-Value testing at the locations shown on the attached site plan. The samples were tested in accordance with the State of California Materials Manual Test Designation 301. The results of the tests are as follows:

Sample	Depth	Description	R-Value at Equilibrium
1	12-24"	Sandy Clay	Less than 5
2	12-24"	Sandy Clay	Less than 5

The test results are low and indicate poor subgrade support characteristics under dynamic traffic loads. The following table shows the recommended pavement sections for various traffic indices based on the CalTrans design procedure.

Traffic Index	Asphaltic Concrete	Class II Aggregate Base*	Class III Aggregate Subbase	Compacted Subgrade**
4.0	2.0"	8.5"	--	12.0"
4.0	2.0"	4.5"	4.5"	12.0"
4.5	2.5"	9.0"	--	12.0"
4.5	2.5"	4.0"	5.5"	12.0"
5.0	2.5"	10.5"	--	12.0"
5.0	2.5"	5.0"	6.0"	12.0"
5.5	3.0"	11.0"	--	12.0"
5.5	3.0"	5.0"	7.0"	12.0"
6.0	3.0"	13.5"	--	12.0"
6.0	3.0"	6.5"	7.5"	12.0"
6.5	3.5"	14.0"	--	12.0"
6.5	3.5"	6.0"	9.0"	12.0"
7.0	4.0"	15.0"	--	12.0"
7.0	4.0"	6.5"	9.5"	12.0"
7.5	4.0"	17.0"	--	12.0"
7.5	4.0"	7.5"	10.0"	12.0"

**** 95% compaction based on ASTM Test Method D1557 or CAL 216***
***** 90% compaction based on ASTM Test Method D1557 or CAL 216***

If traffic indices are not available, an estimated (typical value) index of 4.5 may be used for light automobile traffic, and an index of 7.0 may be used for light truck traffic.

The following recommendations are for light-duty and heavy-duty Portland Cement Concrete Pavement Sections based on the design procedures developed by the Portland Cement Association.

PORTLAND CEMENT PAVEMENT
LIGHT DUTY

Traffic Index	Portland Cement Concrete***	Class II Aggregate Base*	Compacted Subgrade**
4.5	6.0"	5.0"	12.0"

HEAVY DUTY

Traffic Index	Portland Cement Concrete***	Class II Aggregate Base*	Compacted Subgrade**
7.0	7.0"	6.0"	12.0"

** 95% compaction based on ASTM Test Method D1557 or CAL 216*
*** 90% compaction based on ASTM Test Method D1557 or CAL 216*
****Minimum Compressive Strength of 3000 psi*

As indicated previously, fill material is located across the site. It is recommended that any uncertified fill material encountered within pavement areas, be removed and/or recompacted. The fill materials should be moisture-conditioned to a minimum of 2 percent above optimum moisture and recompacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557. As an alternative, the Owner may elect not to recompact the existing fill within paved areas. However, the Owner should be aware that the paved areas may settle which may require annual maintenance. At a minimum, it is recommended that the upper 12 inches of subgrade soil be moisture-conditioned and recompacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557.

Seismic Parameters – 2013 California Building Code

The Site Class per Section 1613 of the 2013 California Building Code (2013 CBC) and Table 20.3-1 of ASCE 7-10 is based upon the site soil conditions. It is our opinion that a Site Class D is most consistent with the subject site soil conditions. For seismic design of the structures based on the seismic provisions of the 2013 CBC, we recommend the following parameters:

Seismic Item	Value	CBC Reference
Site Class	D	Section 1613.3.2
Site Coefficient F_a	1.000	Table 1613.3.3 (1)
S_s	1.500	Section 1613.3.1
S_{MS}	1.500	Section 1613.3.3
S_{DS}	1.000	Section 1613.3.4
Site Coefficient F_v	1.500	Table 1613.3.3 (2)

S_1	0.600	Section 1613.3.1
S_{M1}	0.900	Section 1613.3.3
S_{D1}	0.600	Section 1613.3.4

Soil Cement Reactivity

Excessive sulfate in either the soil or native water may result in an adverse reaction between the cement in concrete (or stucco) and the soil. HUD/FHA and CBC have developed criteria for evaluation of sulfate levels and how they relate to cement reactivity with soil and/or water.

Soil samples were obtained from the site and tested in accordance with State of California Materials Manual Test Designation 417. The sulfate concentrations detected in these soil samples were greater than 150 ppm and are above the maximum allowable values established by HUD/FHA and CBC. Therefore, it is recommended that a Type II cement be used within the concrete to compensate for sulfate reactivity with the cement.

Chemical tests were performed on a near-surface soil sample. The test results indicate that the soils are slightly to moderately corrosive to buried metal objects. Therefore, buried metal should be protected using either non-corrosive backfill, protective coatings, wrappings, sacrificial anodes, or a combination of these methods in accordance with the manufacturer's recommendations.

Compacted Material Acceptance

Compaction specifications are not the only criteria for acceptance of the site grading or other such activities. However, the compaction test is the most universally recognized test method for assessing the performance of the Grading Contractor. The numerical test results from the compaction test cannot be used to predict the engineering performance of the compacted material. Therefore, the acceptance of compacted materials will also be dependent on the stability of that material. The Soils Engineer has the option of rejecting any compacted material regardless of the degree of compaction if that material is considered to be unstable or if future instability is suspected. A specific example of rejection of fill material passing the required percent compaction is a fill which has been compacted with an in situ moisture content significantly less than optimum moisture. This type of dry fill (brittle fill) is susceptible to future settlement if it becomes saturated or flooded.

Testing and Inspection

A representative of Krazan & Associates, Inc. should be present at the site during the earthwork activities to confirm that actual subsurface conditions are consistent with the exploratory fieldwork. This activity is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. This representative can also verify that the intent of these recommendations is incorporated into the project design and construction. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor.

LIMITATIONS

Soils Engineering is one of the newest divisions of Civil Engineering. This branch of Civil Engineering is constantly improving as new technologies and understanding of earth sciences advance. Although your site was analyzed using the most appropriate and most current techniques and methods, undoubtedly there will be substantial future improvements in this branch of engineering. In addition to advancements in the field of Soils Engineering, physical changes in the site, either due to excavation or fill placement, new agency regulations, or possible changes in the proposed structure after the soils report is completed may require the soils report to be professionally reviewed. In light of this, the Owner should be aware that there is a practical limit to the usefulness of this report without critical review. Although the time limit for this review is strictly arbitrary, it is suggested that 2 years be considered a reasonable time for the usefulness of this report.

Foundation and earthwork construction is characterized by the presence of a calculated risk that soil and groundwater conditions have been fully revealed by the original foundation investigation. This risk is derived from the practical necessity of basing interpretations and design conclusions on limited sampling of the earth. The recommendations made in this report are based on the assumption that soil conditions do not vary significantly from those disclosed during our field investigation. If any variations or undesirable conditions are encountered during construction, the Soils Engineer should be notified so that supplemental recommendations may be made.

The conclusions of this report are based on the information provided regarding the proposed construction. If the proposed construction is relocated or redesigned, the conclusions in this report may not be valid. The Soils Engineer should be notified of any changes so the recommendations may be reviewed and re-evaluated.

This report is a Geotechnical Engineering Investigation with the purpose of evaluating the soil conditions in terms of foundation design. The scope of our services did not include any Environmental Site Assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater, or atmosphere; or the presence of wetlands. Any statements, or absence of statements, in this report or on any boring log regarding odors, unusual or suspicious items, or conditions observed, are strictly for descriptive purposes and are not intended to convey engineering judgment regarding potential hazardous and/or toxic assessment.

The geotechnical engineering information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical engineering developments. We emphasize that this report is valid for the project outlined above and should not be used for any other sites.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (925) 307-1160.

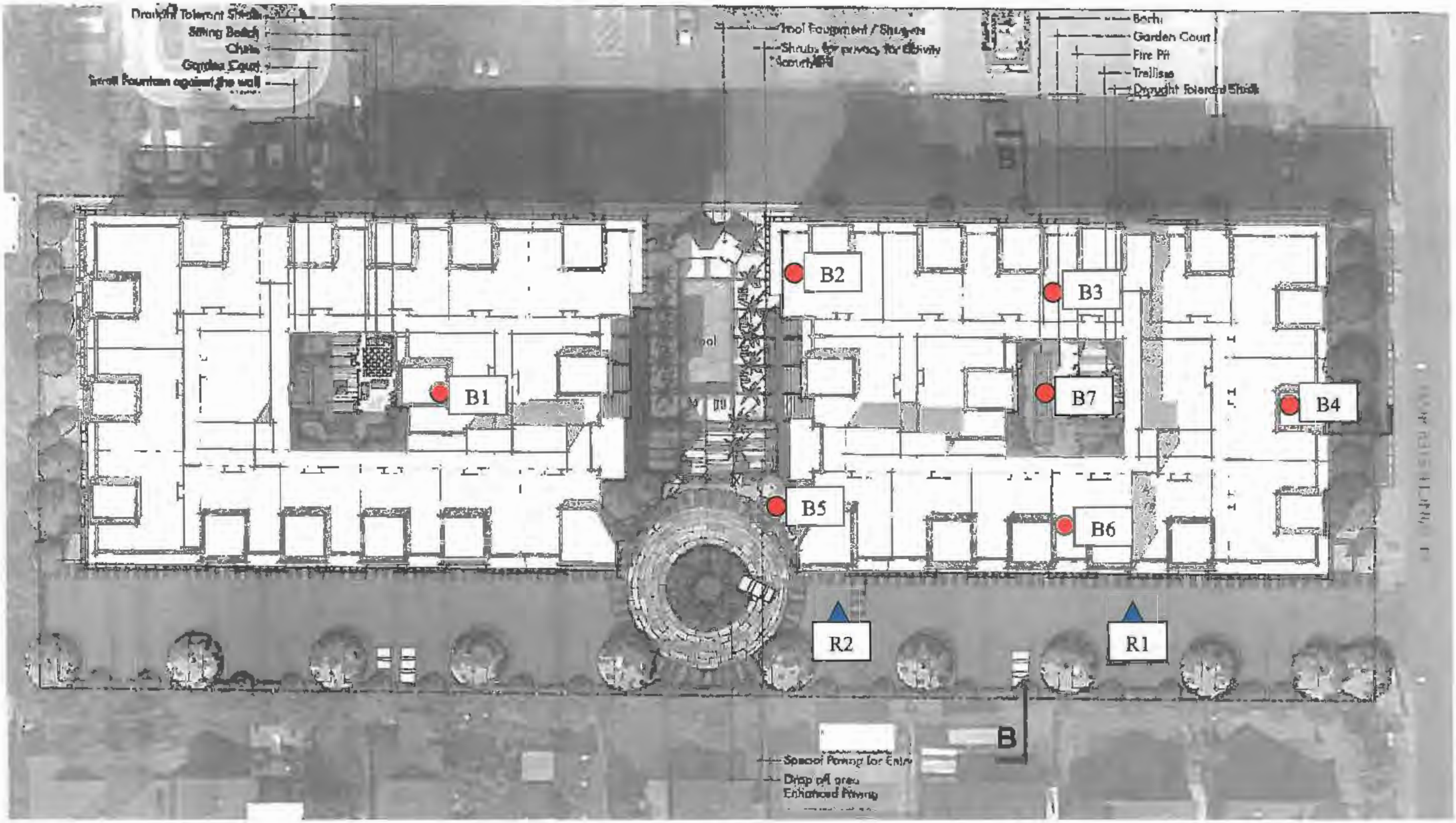
Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

REGISTERED PROFESSIONAL ENGINEER
DAVID R. JAROSZ, II
NO. 2698
Expires June 30, 2016
GEOTECHNICAL
STATE OF CALIFORNIA

Steve Nelson
Project Engineer

David R. Jarosz, II
Managing Engineer
RGE No. 2698/RCE No. 60185

SN/DRJ:ht



APPROXIMATE BORING LOCATION

APPROXIMATE R-VALUE LOCATION

SITE MAP	Scale: NTS	Date: March 2015	Krazan GEOTECHNICAL ENGINEERING
Santana Atrium Senior Apartments **100 N. Winchester Boulevard** **Santa Clara, California**	Drawn by: HT	Approved by: DJ	
	Project No. 042-15006	Figure No. 1	

APPENDIX A

FIELD AND LABORATORY INVESTIGATIONS

Field Investigation

The field investigation consisted of a surface reconnaissance and a subsurface exploratory program. Seven 4½-inch diameter exploratory borings were advanced. The boring locations are shown on the attached site plan.

The soils encountered were logged in the field during the exploration and with supplementary laboratory test data are described in accordance with the Unified Soil Classification System.

Modified standard penetration tests and standard penetration tests were performed at selected depths. This test represents the resistance to driving a 2½-inch and 1½-inch diameter split barrel sampler, respectively. The driving energy was provided by a hammer weighing 140 pounds falling 30 inches. Relatively undisturbed soil samples were obtained while performing this test. Bag samples of the disturbed soil were obtained from the auger cuttings. The modified standard penetration tests are identified in the sample type on the boring logs with a full shaded in block. The standard penetration tests are identified in the sample type on the boring logs with one-half of the block shaded. All samples were returned to our Clovis laboratory for evaluation.

Laboratory Investigation

The laboratory investigation was programmed to determine the physical and mechanical properties of the foundation soil underlying the site. Test results were used as criteria for determining the engineering suitability of the surface and subsurface materials encountered.

In-situ moisture content, dry density, consolidation, direct shear, atterberg limits and sieve analysis tests were completed for the undisturbed samples representative of the subsurface material. Expansion index and R-value tests were completed for select bag samples obtained from the auger cuttings. These tests, supplemented by visual observation, comprised the basis for our evaluation of the site material.

The logs of the exploratory borings and laboratory determinations are presented in this Appendix.

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	
	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

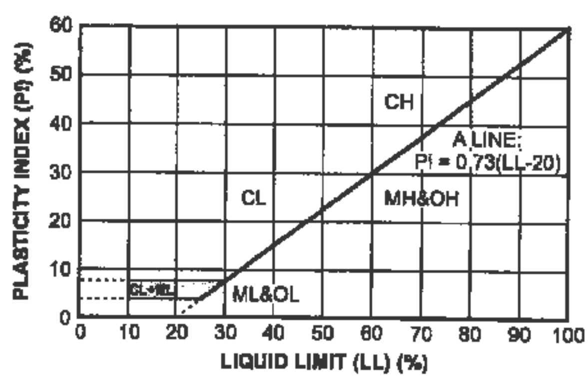
CONSISTENCY CLASSIFICATION

Description	Blows per Foot
Granular Soils	
Very Loose	< 5
Loose	5 – 15
Medium Dense	16 – 40
Dense	41 – 65
Very Dense	> 65
Cohesive Soils	
Very Soft	< 3
Soft	3 – 5
Firm	6 – 10
Stiff	11 – 20
Very Stiff	21 – 40
Hard	> 40

GRAIN SIZE CLASSIFICATION

Grain Type	*Standard Sieve Size*	*Grain Size in Millimeters*
Boulders	Above 12 inches	Above 305
Cobbles	12 to 13 inches	305 to 76.2
Gravel	3 inches to No. 4	76.2 to 4.76
Coarse-grained	3 to ¾ inches	76.2 to 19.1
Fine-grained	¾ inches to No. 4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.074
Coarse-grained	No. 4 to No. 10	4.76 to 2.00
Medium-grained	No. 10 to No. 40	2.00 to 0.042
Fine-grained	No. 40 to No. 200	0.042 to 0.074
Silt and Clay	Below No. 200	Below 0.074

PLASTICITY CHART



Log of Boring B1

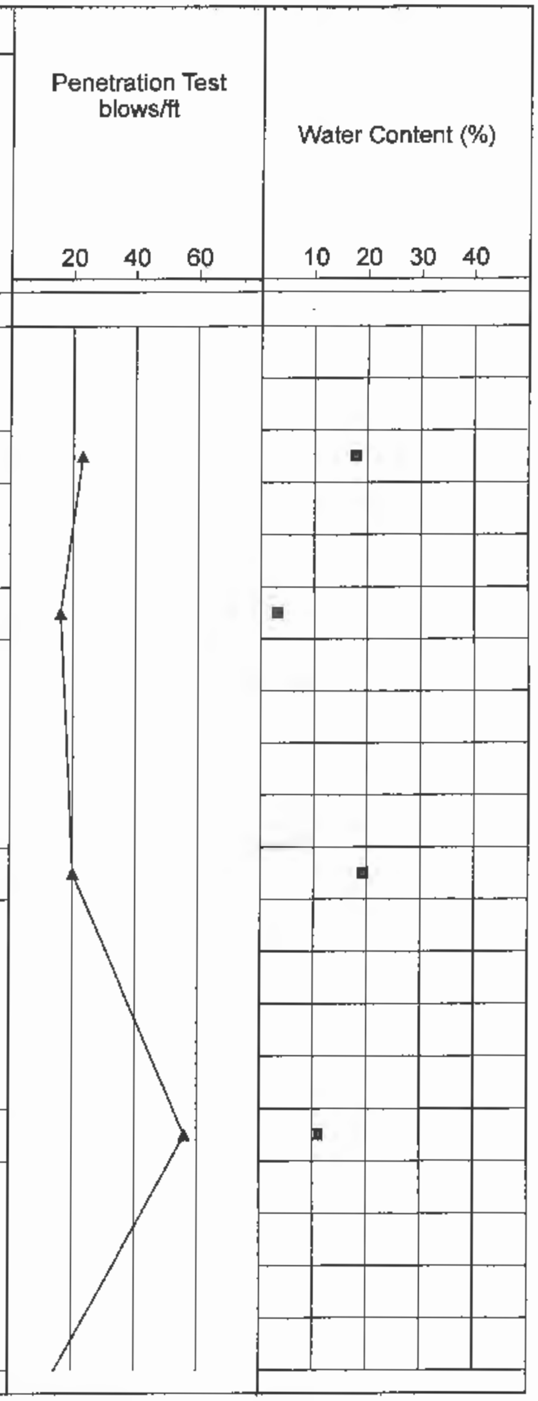
Project: Santana Atrium Senior Apartments | **Project No:** 042-15006

Client: USA Properties Fund, Inc. | **Figure No.:** A-1

Location: 100 N. Winchester Boulevard, Santa Clara, CA | **Logged By:** R. Alexander

Depth to Water> | **Initial:** None | **At Completion:** None

Depth (ft)	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0	Ground Surface				
0	ASPHALTIC CONCRETE = 4 inches AGGREGATE BASE = 4 inches				
	GRAVELLY SILTY SAND (SM) FILL, fine- to coarse-grained; brown, damp, drills easily	122.6	17.9		23
	SANDY SILTY CLAY (CL) FILL, fine- to coarse-grained; brown, damp, drills easily				
	SILTY SANDY CLAY (CL) Very stiff, fine- to coarse-grained; light brown, damp, drills easily	136.2	3.2		16
	SILTY SAND (SM) Medium dense, fine- to coarse-grained with trace GRAVEL; light brown, damp, drills easily				
	SANDY CLAY (CL) Stiff, fine- to coarse-grained with GRAVEL; light brown, damp, drills easily	121.1	19.3		20
	SANDY CLAY (CL) Stiff, fine- to coarse-grained with GRAVEL; light brown, damp, drills easily				
	CLAYEY SAND (SC) Dense, fine- to coarse-grained with GRAVEL; brown, damp, drills firmly	133.9	10.9		56
	SILTY SAND (SM) Loose, fine- to coarse-grained with GRAVEL; brown, damp, drills easily				
20					



Drill Method: Solid Flight | **Drill Date:** 3-10-15

Drill Rig: CME 45B | **Hole Size:** 4½ Inches

Driller: Brent Snyder | **Elevation:** 44 Feet

Krazan and Associates

Log of Boring B1

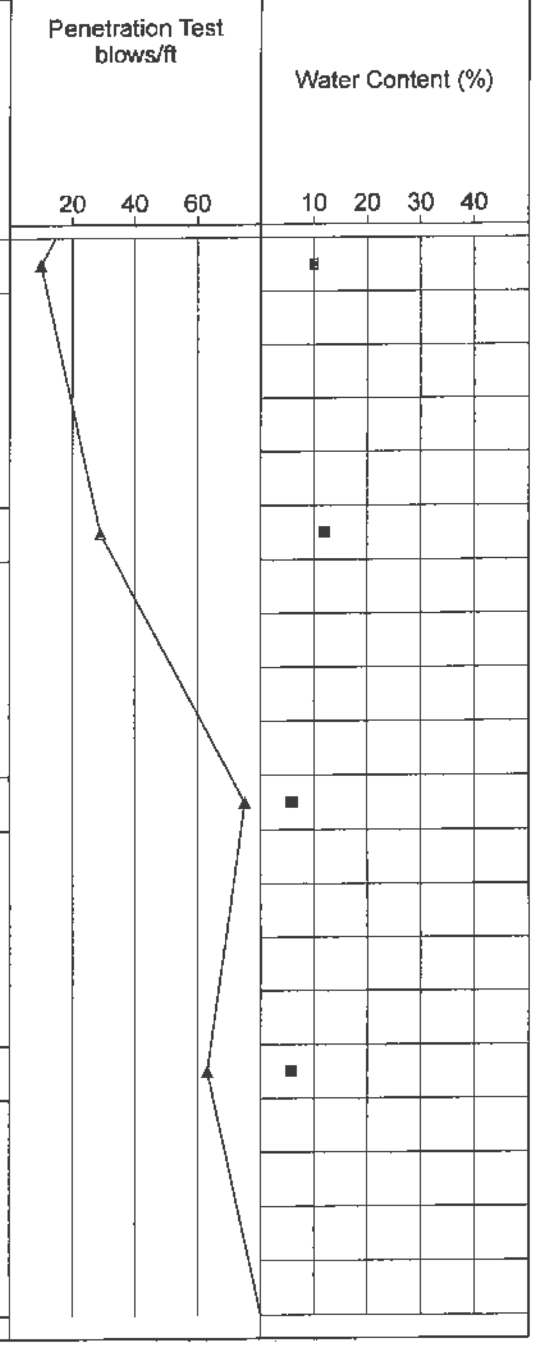
Project: Santana Atrium Senior Apartments | **Project No:** 042-15006

Client: USA Properties Fund, Inc. | **Figure No.:** A-1

Location: 100 N. Winchester Boulevard, Santa Clara, CA | **Logged By:** R. Alexander

Depth to Water> | **Initial:** None | **At Completion:** None

Depth (ft)	Description (SUBSURFACE PROFILE)	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
			9.9		10
22	***SILTY CLAY (CL)*** Firm, fine- to coarse-grained; brown, damp, drills easily				
24	***SILTY SAND/SANDY SILT (SM/ML)*** Dense, fine- to coarse-grained; brown, damp, drills firmly	125.0	12.1		29
26					
28	***SILTY SAND (SM)*** Very dense, fine- to coarse-grained with trace GRAVEL; brown, moist, drills firmly				
30		128.4	5.9		75
32	***SILTY SAND (SM)*** Very dense, fine- to coarse-grained with trace GRAVEL; brown, damp, drills firmly				
34					
36		118.7	5.8		63
38					
40					[illegible]



Drill Method: Solid Flight

Drill Rig: CME 45B

Driller: Brent Snyder

Krazan and Associates

Drill Date: 3-10-15

Hole Size: 4½ Inches

Elevation: 44 Feet

Log of Boring B1

Project: Santana Atrium Senior Apartments	Project No: 042-15006
Client: USA Properties Fund, Inc.	Figure No.: A-1
Location: 100 N. Winchester Boulevard, Santa Clara, CA	Logged By: R. Alexander
Depth to Water> Initial: None	At Completion: None

SUBSURFACE PROFILE			SAMPLE				Penetration Test blows/ft	Water Content (%)
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.	20 40 60	10 20 30 40
42			132.4	3.9		90		
44		End of Borehole						
46								
48								
50								
52								
54								
56								
58								
60								

Drill Method: Solid Flight		Drill Date: 3-10-15
Drill Rig: CME 45B	**Krazan and Associates**	Hole Size: 4½ Inches
Driller: Brent Snyder		Elevation: 44 Feet

Log of Boring B2

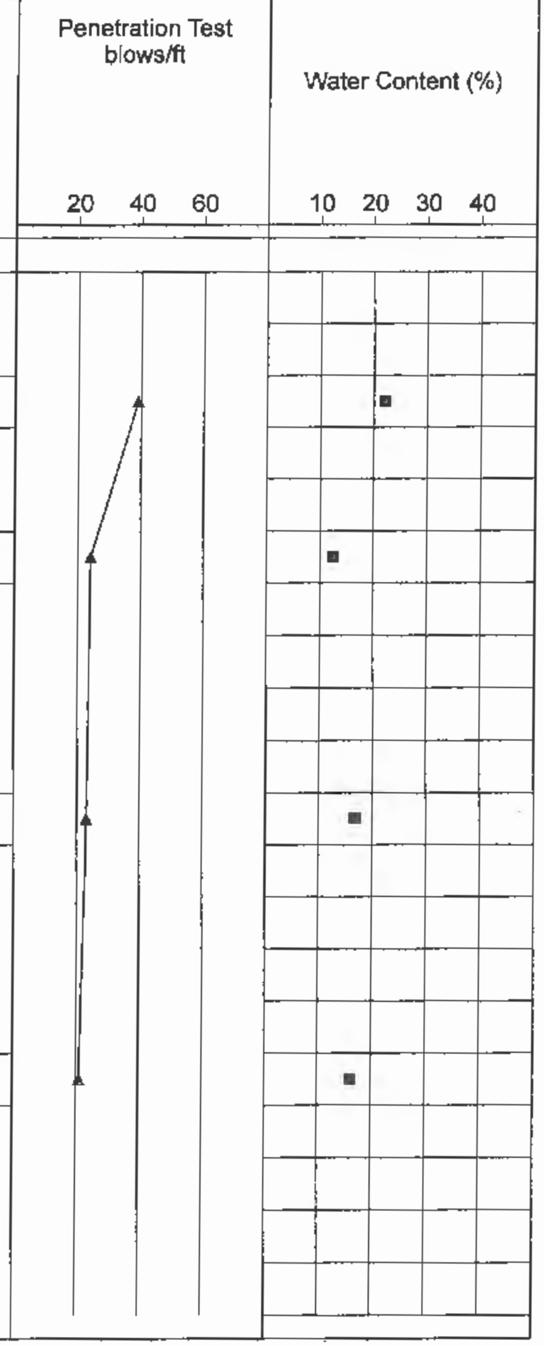
Project: Santana Atrium Senior Apartments | **Project No:** 042-15006

Client: USA Properties Fund, Inc. | **Figure No.:** A-2

Location: 100 N. Winchester Boulevard, Santa Clara, CA | **Logged By:** R. Alexander

Depth to Water> **Initial:** None | **At Completion:** None

Depth (ft)	Description (Subsurface Profile)	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0	Ground Surface				
0–1.7	***GRAVELLY SILTY SAND (SM)*** FILL, fine- to coarse-grained; brown, damp, drills easily				
1.7–3.3	***SILTY CLAY (CL)*** FILL, fine- to coarse-grained; dark brown, damp, drills easily	93.4	22.2	■	39
3.3–5	***SILTY CLAY (CL)*** Very stiff, fine- to coarse-grained; brown, damp, drills easily				
5–6.5	***CLAYEY SAND/SANDY CLAY (SC/CL)*** Medium dense, fine- to coarse-grained; light brown, damp, drills easily	132.8	12.5	■	24
6.5–10	***SILTY SAND (SM)*** Medium dense, fine- to coarse-grained; brown, damp, drills easily				
10–13.5	***SILTY CLAY (CL)*** Very stiff, fine- to coarse-grained; brown, damp, drills easily	112.8	16.9	■	23
13.5–20	***CLAYEY SAND/SANDY CLAY (SC/CL)*** Medium dense, fine- to coarse-grained; light brown, damp, drills easily	110.1	16.3	■	21



Drill Method: Solid Flight

Drill Rig: CME 45B

Driller: Brent Snyder

Krazan and Associates

Drill Date: 3-10-15

Hole Size: 4½ Inches

Elevation: 20 Feet

Sheet: 1 of 1

Log of Boring B3

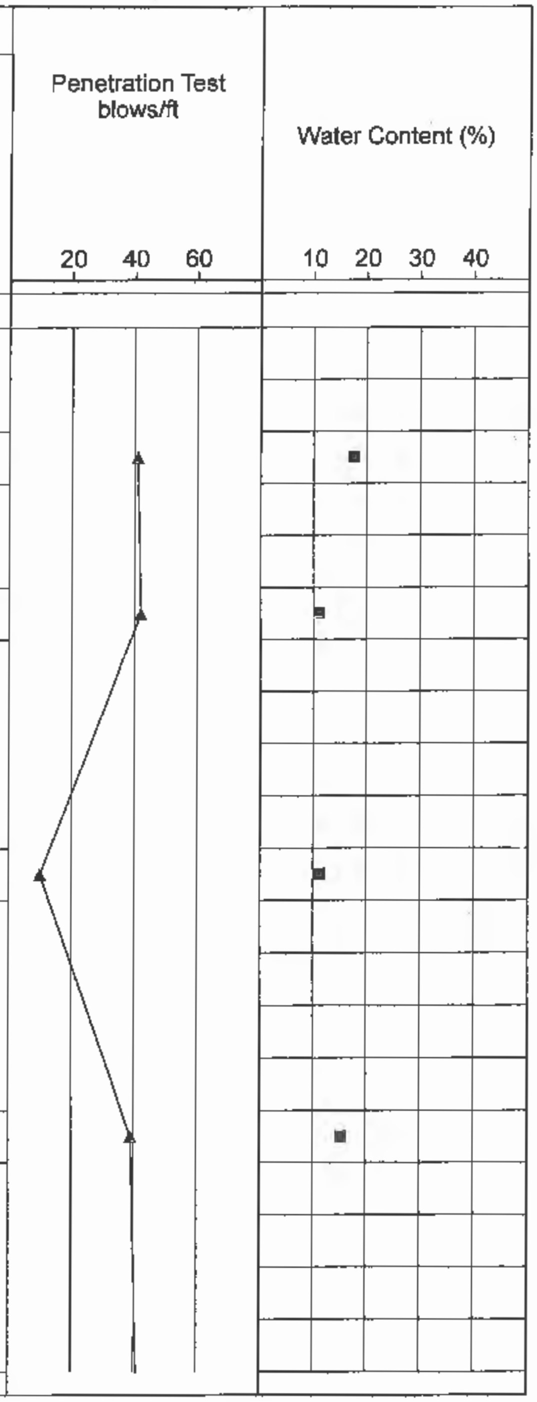
Project: Santana Atrium Senior Apartments | **Project No:** 042-15006

Client: USA Properties Fund, Inc. | **Figure No.:** A-3

Location: 100 N. Winchester Boulevard, Santa Clara, CA | **Logged By:** R. Alexander

Depth to Water> | **Initial:** None | **At Completion:** None

Depth (ft)	Description (Subsurface Profile)	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0	Ground Surface				
0	ASPHALTIC CONCRETE = 4 inches AGGREGATE BASE = 4 inches				
	GRAVELLY SILTY SAND (SM) FILL, fine- to coarse-grained; brown, damp, drills easily	105.0	17.7		41
	SILTY CLAY (CL) FILL, fine- to coarse-grained; dark brown, damp, drills easily				
	SILTY CLAY (CL) Very stiff, fine- to coarse-grained; brown, damp, drills easily	113.5	11.2		42
	CLAYEY SAND (SC) Medium dense, fine- to coarse-grained; light brown, damp, drills firmly				
10		121.2	11.4		40
	SILTY SANDY CLAY (CL) Hard, fine- to coarse-grained; light brown, damp, drills firmly				
14	Very stiff below 14 feet				
		115.1	15.3		39
	GRAVELLY SILTY SAND (SM) Medium dense; light brown, damp, drills easily				
20					



Drill Method: Solid Flight | **Drill Date:** 3-10-15

Drill Rig: CME 45B | **Krazan and Associates** | **Hole Size:** 4½ Inches

Driller: Brent Snyder | **Elevation:** 25 Feet

Log of Boring B3

Project: Santana Atrium Senior Apartments
Project No: 042-15006

Client: USA Properties Fund, Inc.
Figure No.: A-3

Location: 100 N. Winchester Boulevard, Santa Clara, CA
Logged By: R. Alexander

Depth to Water> **Initial:** None **At Completion:** None

SUBSURFACE PROFILE			SAMPLE				Penetration Test blows/ft (20 40 60)	Water Content (%) (10 20 30 40)
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.		
20–25		***GRAVELLY SILTY SAND (SM)*** Dense, fine- to coarse-grained; brown, damp, drills firmly	123.8	9.5		41		
25		End of Borehole						

Depth scale (ft): 22, 24, 26, 28, 30, 32, 34, 36, 38, 40

Drill Method: Solid Flight
Drill Rig: CME 45B
Driller: Brent Snyder

Krazan and Associates

Drill Date: 3-10-15
Hole Size: 4½ Inches
Elevation: 25 Feet

Log of Boring B4

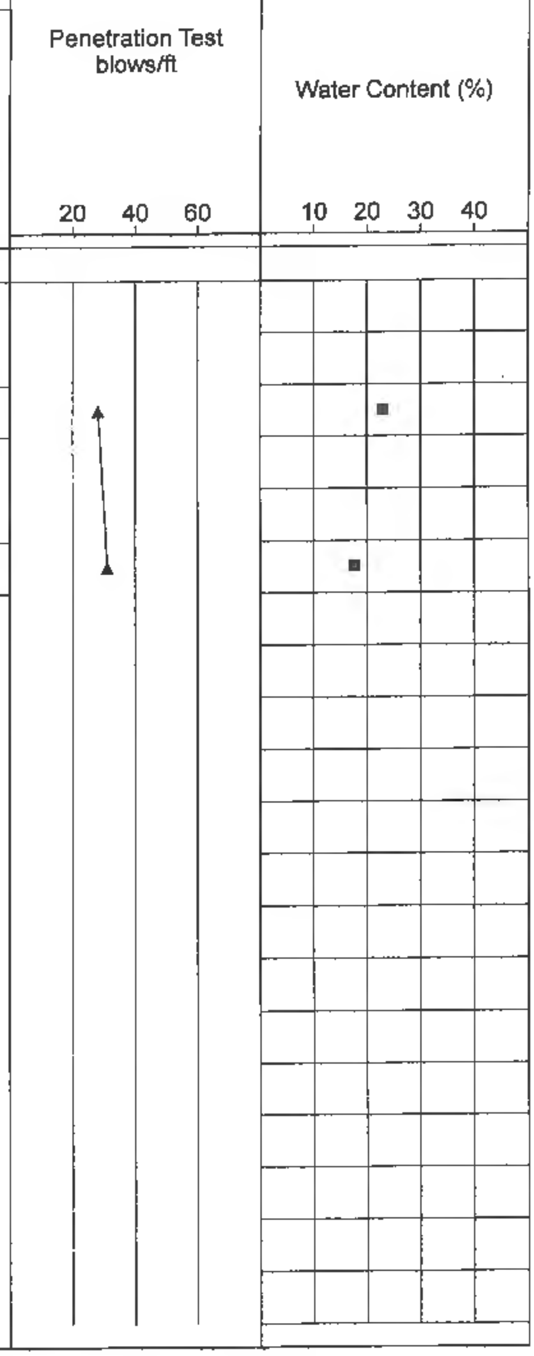
Project: Santana Atrium Senior Apartments | **Project No:** 042-15006

Client: USA Properties Fund, Inc. | **Figure No.:** A-4

Location: 100 N. Winchester Boulevard, Santa Clara, CA | **Logged By:** R. Alexander

Depth to Water> **Initial:** None | **At Completion:** None

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		ASPHALTIC CONCRETE = 4 inches AGGREGATE BASE = 4 inches				
2		***SILTY CLAY (CL)*** FILL, fine- to coarse-grained; brown, damp, drills easily	112.1	23.1		28
4		***SILTY CLAY (CL)*** Very stiff, fine- to coarse-grained; brown, damp, drills easily				
6		***SANDY CLAY (CL)*** Very stiff, fine- to coarse-grained; light brown, damp, drills easily	119.7	17.6		31
8						
10		End of Borehole				
12						
14						
16						
18						
20						



Drill Method: Solid Flight | **Drill Date:** 3-10-15

Drill Rig: CME 45B | **Hole Size:** 4½ Inches

Krazan and Associates

Driller: Brent Snyder | **Elevation:** 10 Feet

Sheet: 1 of 1

Log of Boring B5

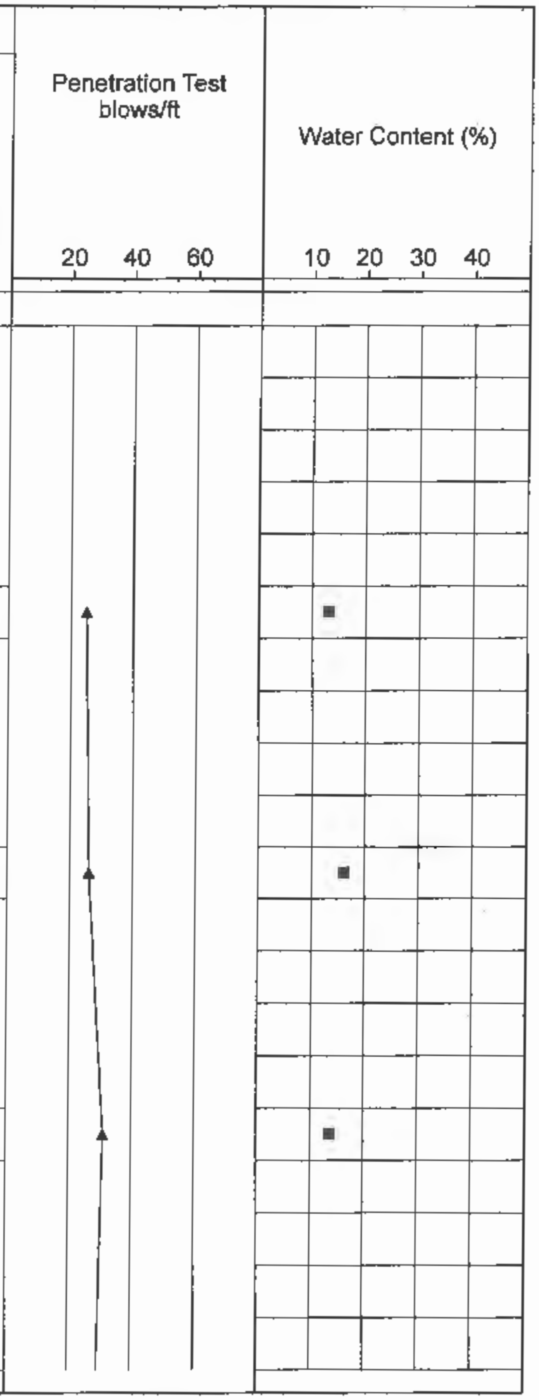
Project: Santana Atrium Senior Apartments — **Project No:** 042-15006

Client: USA Properties Fund, Inc. — **Figure No.:** A-5

Location: 100 N. Winchester Boulevard, Santa Clara, CA — **Logged By:** R. Alexander

Depth to Water> **Initial:** None — **At Completion:** None

Depth (ft)	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0	Ground Surface				
0–2.5	***SILTY CLAY (CL)*** FILL, fine- to coarse-grained; dark brown, damp, drills easily				
2.5–5.5	***SILTY CLAY (CL)*** Firm; brown, damp, drills easily				
5.5–7	***CLAYEY SAND (SC)*** Medium dense, fine- to coarse-grained; light brown, damp, drills easily	129.0	13.1	■	25
7–10	***GRAVELLY SILTY SAND (SM)*** Medium dense, fine- to coarse-grained; light brown, damp, drills easily				
10–15	***SILTY CLAY (CL)*** Very stiff, fine- to coarse-grained; brown, damp, drills easily	124.7	16.1	■	26
15–20	***GRAVELLY CLAYEY SAND (SC)*** Medium dense; light brown, damp, drills easily	123.5	13.8	■	31



Drill Method: Solid Flight — **Drill Date:** 3-10-15

Drill Rig: CME 45B — **Krazan and Associates** — **Hole Size:** 4½ Inches

Driller: Brent Snyder — **Elevation:** 25 Feet

Log of Boring B5

Project: Santana Atrium Senior Apartments
Project No: 042-15006

Client: USA Properties Fund, Inc.
Figure No.: A-5

Location: 100 N. Winchester Boulevard, Santa Clara, CA
Logged By: R. Alexander

Depth to Water> **Initial:** None **At Completion:** None

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.	Penetration Test blows/ft	Water Content (%)
		SILTY CLAY (CL) Very stiff, fine- to coarse-grained; brown, damp, drills easily	122.8	15.1		29		
22								
24								
		End of Borehole						
26								
28								
30								
32								
34								
36								
38								
40								

Penetration Test scale: 20 40 60
Water Content scale: 10 20 30 40

Drill Method: Solid Flight
Drill Date: 3-10-15

Drill Rig: CME 45B
Krazan and Associates
Hole Size: 4½ Inches

Driller: Brent Snyder
Elevation: 25 Feet

Log of Boring B6

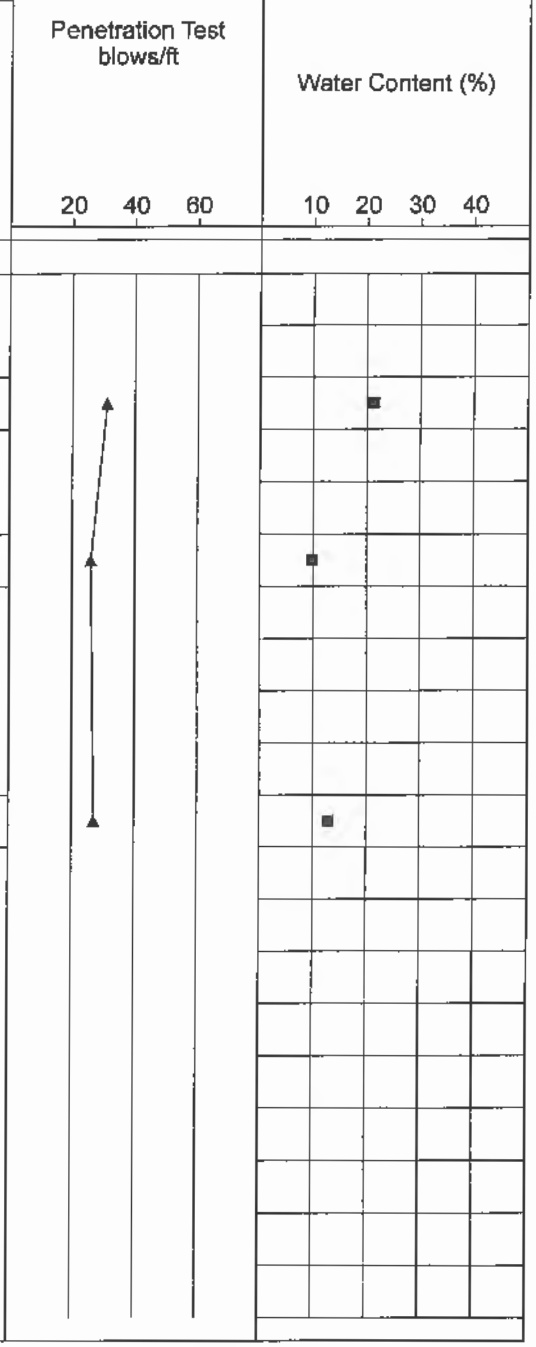
Project: Santana Atrium Senior Apartments — **Project No:** 042-15006

Client: USA Properties Fund, Inc. — **Figure No.:** A-6

Location: 100 N. Winchester Boulevard, Santa Clara, CA — **Logged By:** R. Alexander

Depth to Water> — **Initial:** None — **At Completion:** None

Depth (ft)	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0	Ground Surface				
0–2.5	***SILTY CLAY (CL)*** FILL, fine- to coarse-grained; dark brown, damp, drills easily	111.4	21.4		31
2.5–5.5	***SILTY CLAY (CL)*** Very stiff, fine- to coarse-grained; brown, damp, drills easily	121.5	9.8		26
5.5–15	***CLAYEY SAND (SC)*** Medium dense, fine- to coarse-grained; light brown, damp, drills easily	127.7	13.0		27
15	End of Borehole				



Drill Method: Solid Flight — **Drill Date:** 3-10-15

Drill Rig: CME 45B — **Hole Size:** 4½ Inches

Krazan and Associates

Driller: Brent Snyder — **Elevation:** 15 Feet

Sheet: 1 of 1

Log of Boring B7

Project: Santana Atrium Senior Apartments
Project No: 042-15006

Client: USA Properties Fund, Inc.
Figure No.: A-7

Location: 100 N. Winchester Boulevard, Santa Clara, CA
Logged By: R. Alexander

Depth to Water> **Initial:** None **At Completion:** None

SUBSURFACE PROFILE			SAMPLE				Penetration Test blows/ft	Water Content (%)
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.	20 40 60	10 20 30 40
		Ground Surface						
0		***GRAVELLY SANDY SILT (SM)*** FILL, fine- to coarse-grained; brown, damp, drills easily						
2		***SILTY CLAY (CL)*** FILL, fine- to coarse-grained; brown, moist, drills easily				13		
4		***SILTY CLAY (CL)*** FILL, fine- to coarse-grained; dark brown, damp, drills easily				16		
6–8		***SILTY CLAY (CL)*** Firm, fine- to coarse-grained; brown, damp, drills easily						
10		End of Borehole						
12								
14								
16								
18								
20								

Drill Method: Solid Flight
Drill Date: 3-10-15

Drill Rig: CME 45B
Hole Size: 4½ Inches

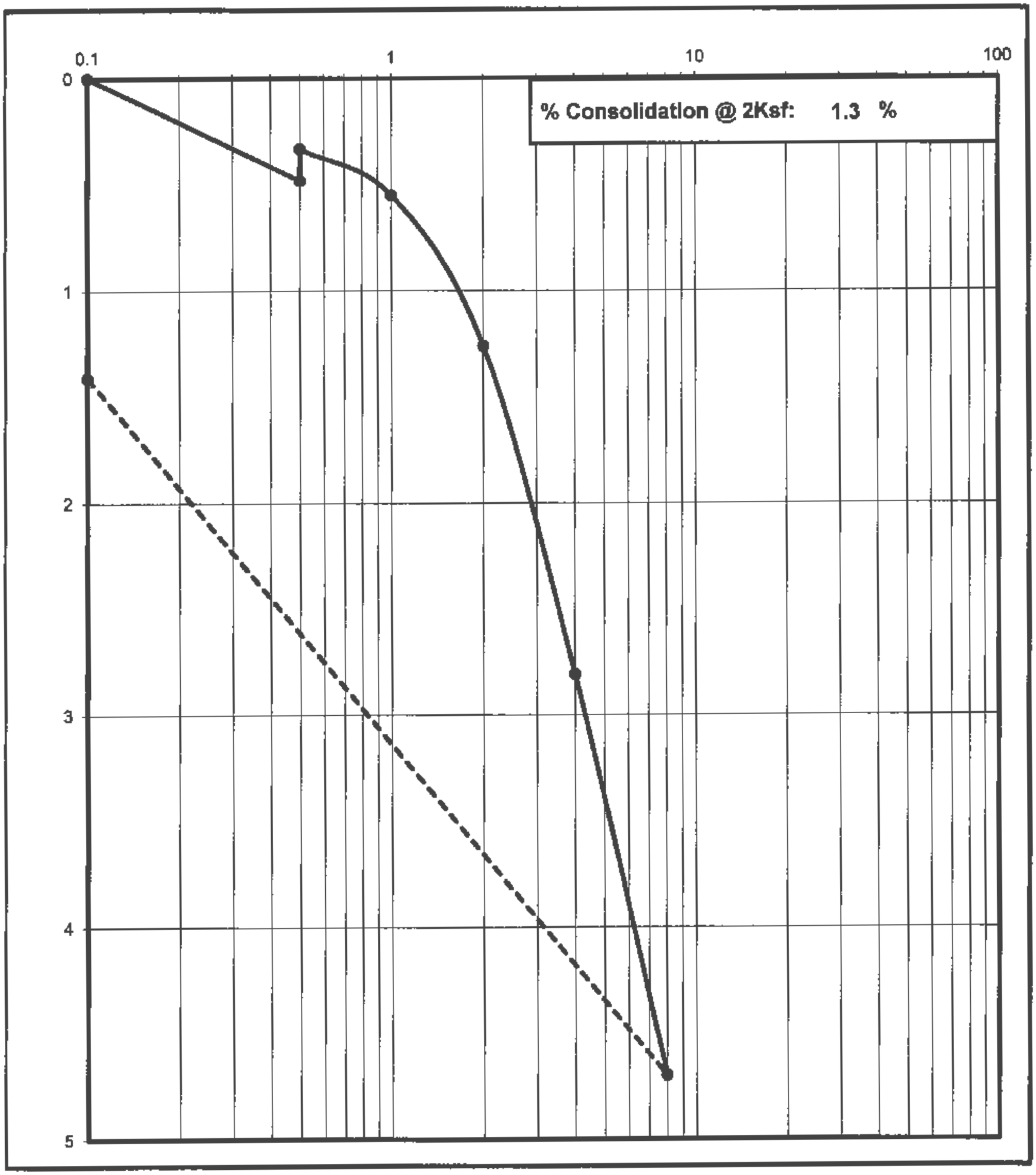
Krazan and Associates

Driller: Brent Snyder
Elevation: 10 Feet

Sheet: 1 of 1

Consolidation Test

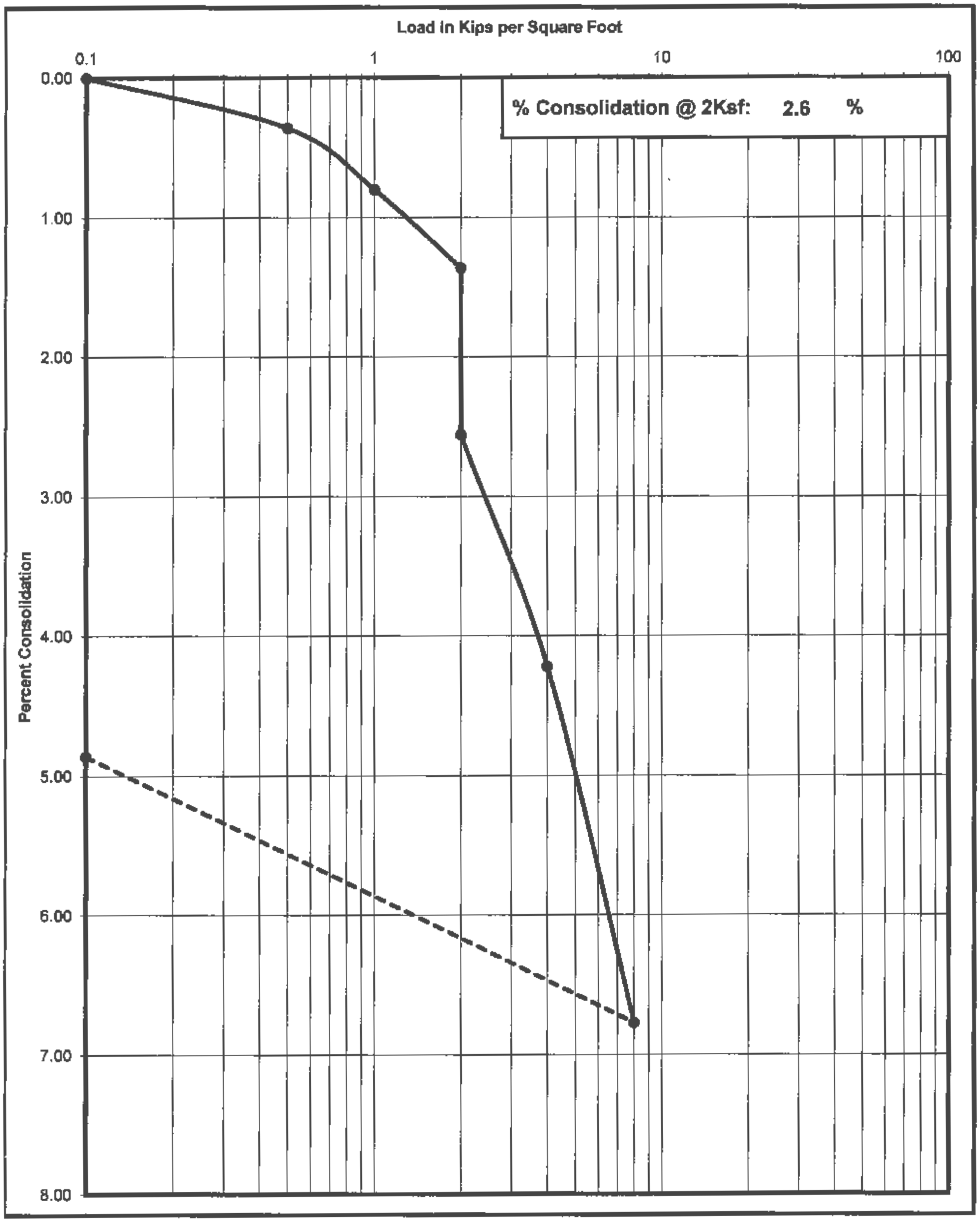
Project No	Boring No. & Depth	Date	Soil Classification
4215006	B1 @ 2-3'	3/24/2015	CL



Krazan Testing Laboratory

Consolidation Test

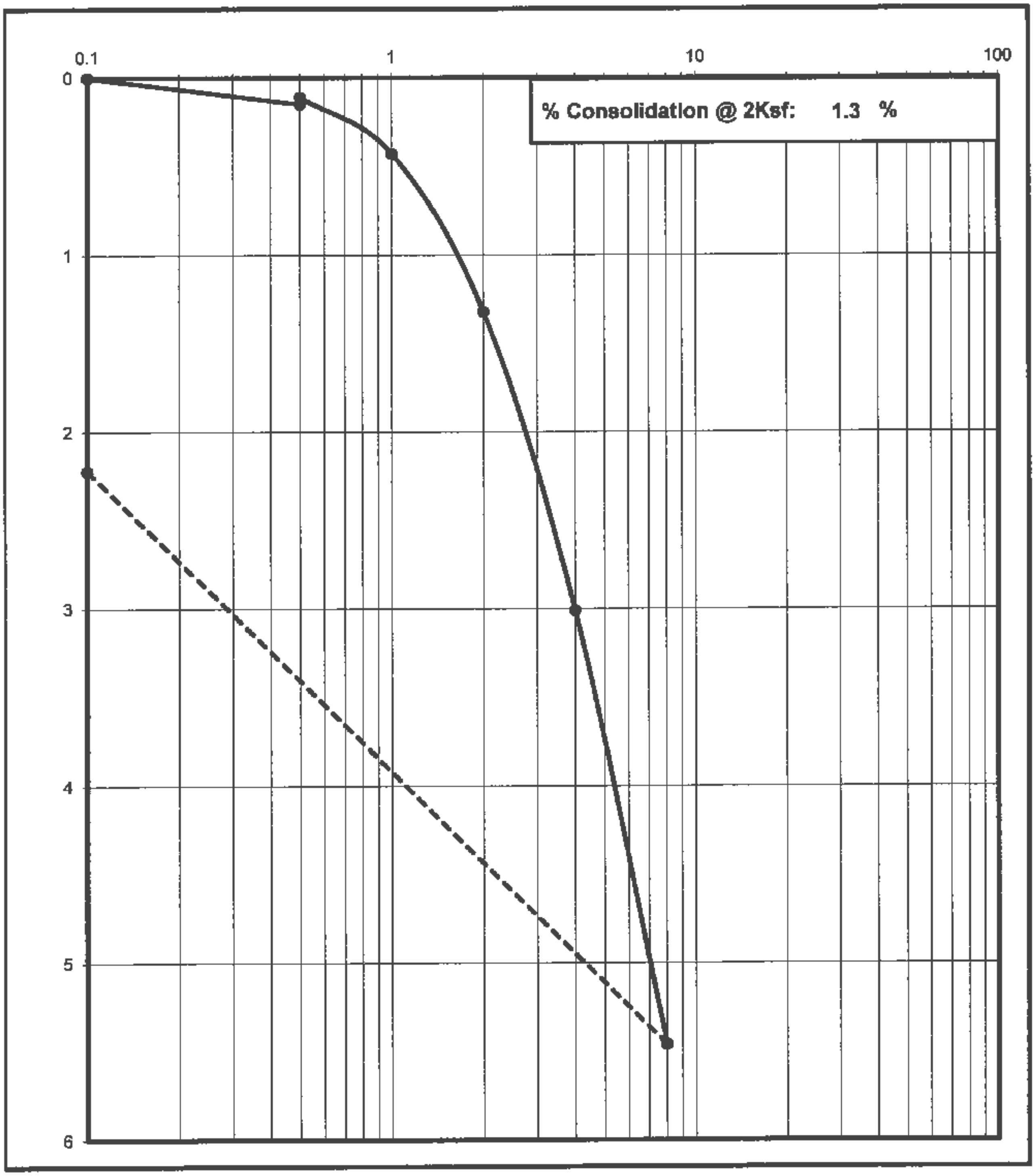
Project No	Boring No. & Depth	Date	Soil Classification
4215006	B1 @ 5-6'	3/24/2015	SM



Krazan Testing Laboratory

Consolidation Test

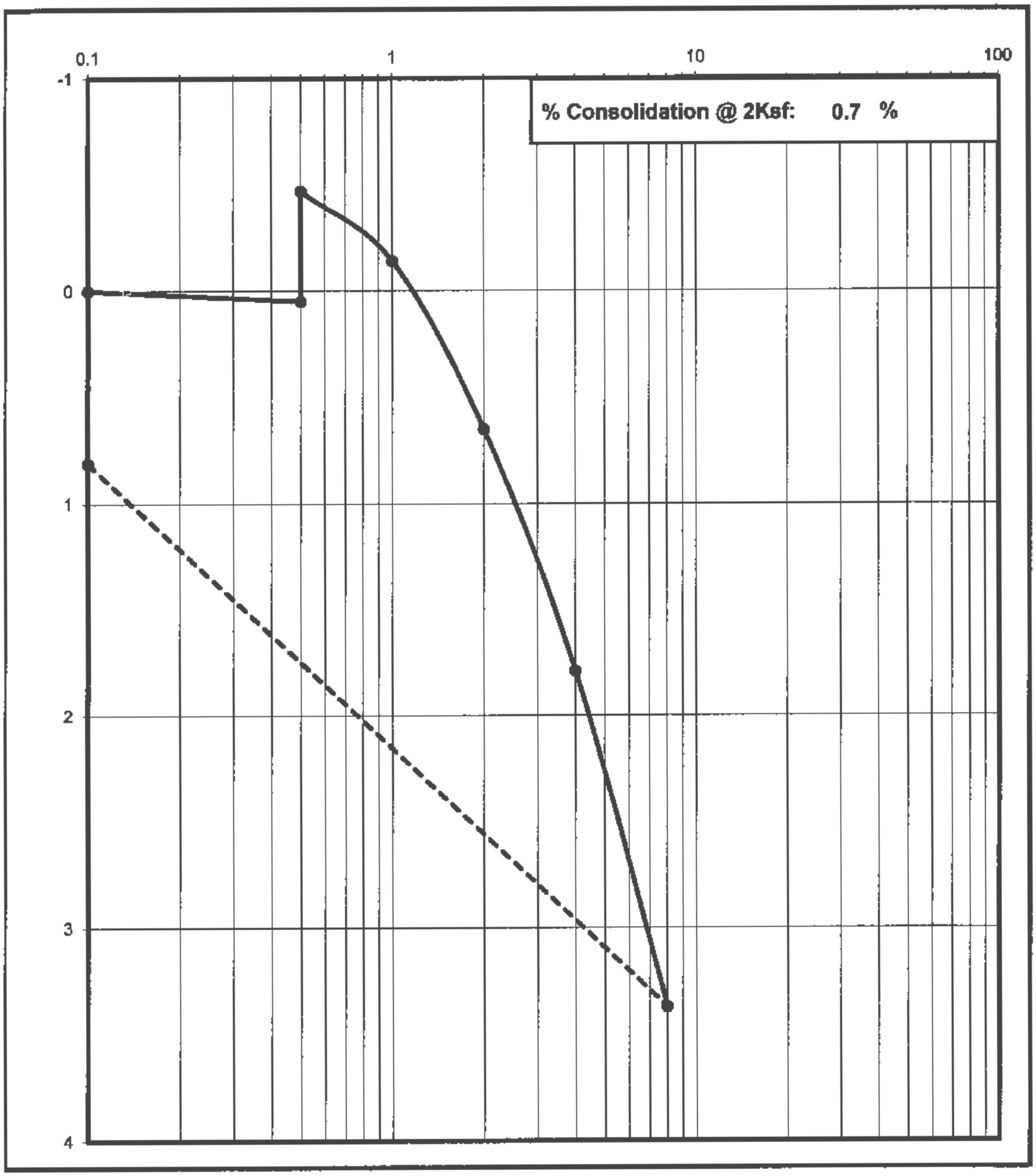
Project No	Boring No. & Depth	Date	Soil Classification
4215006	B4 @ 2-3'	3/24/2015	CL



Krazan Testing Laboratory

Consolidation Test

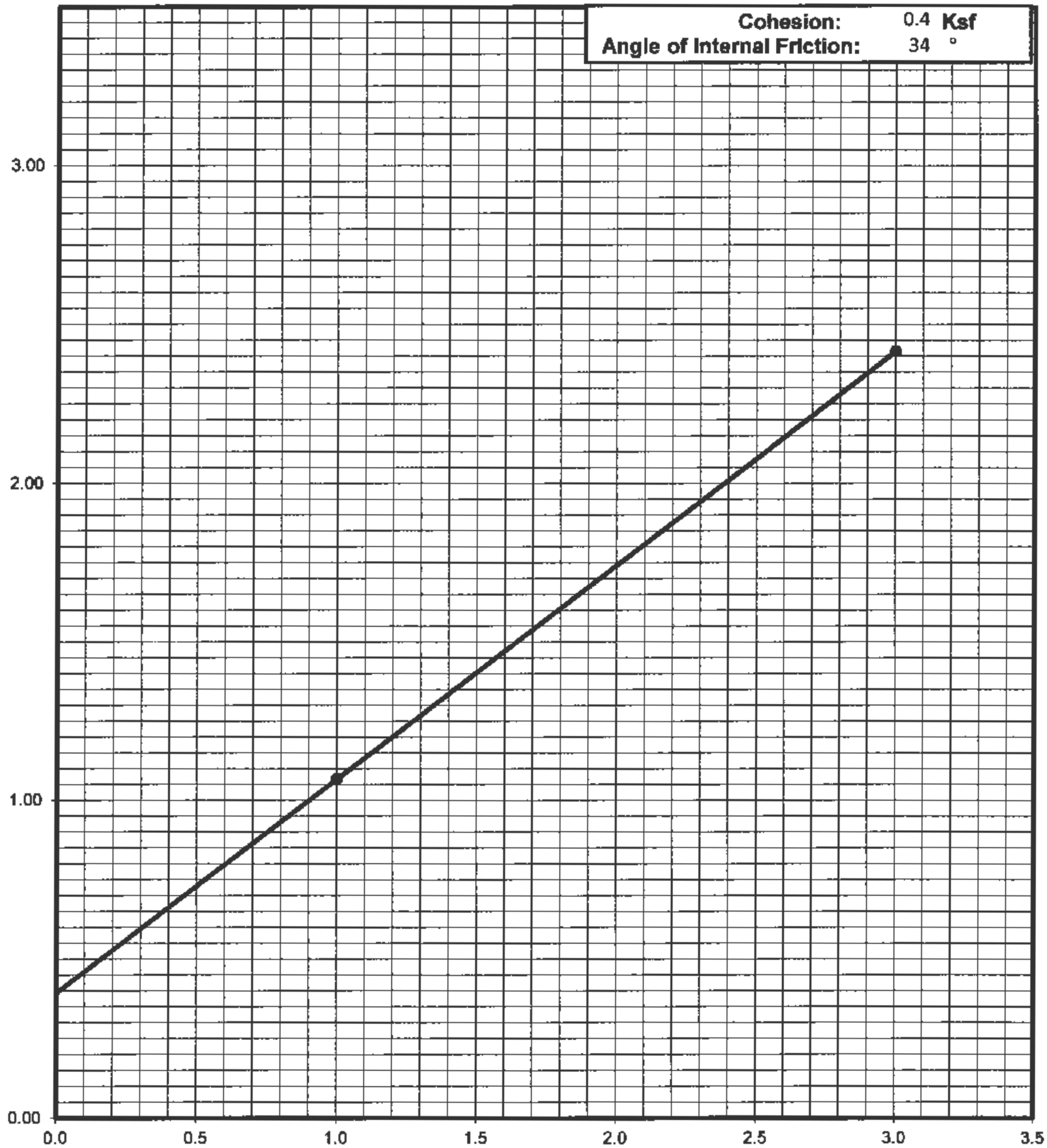
Project No	Boring No. & Depth	Date	Soil Classification
4215006	B4 @ 5-6'	3/24/2015	CL



Krazan Testing Laboratory

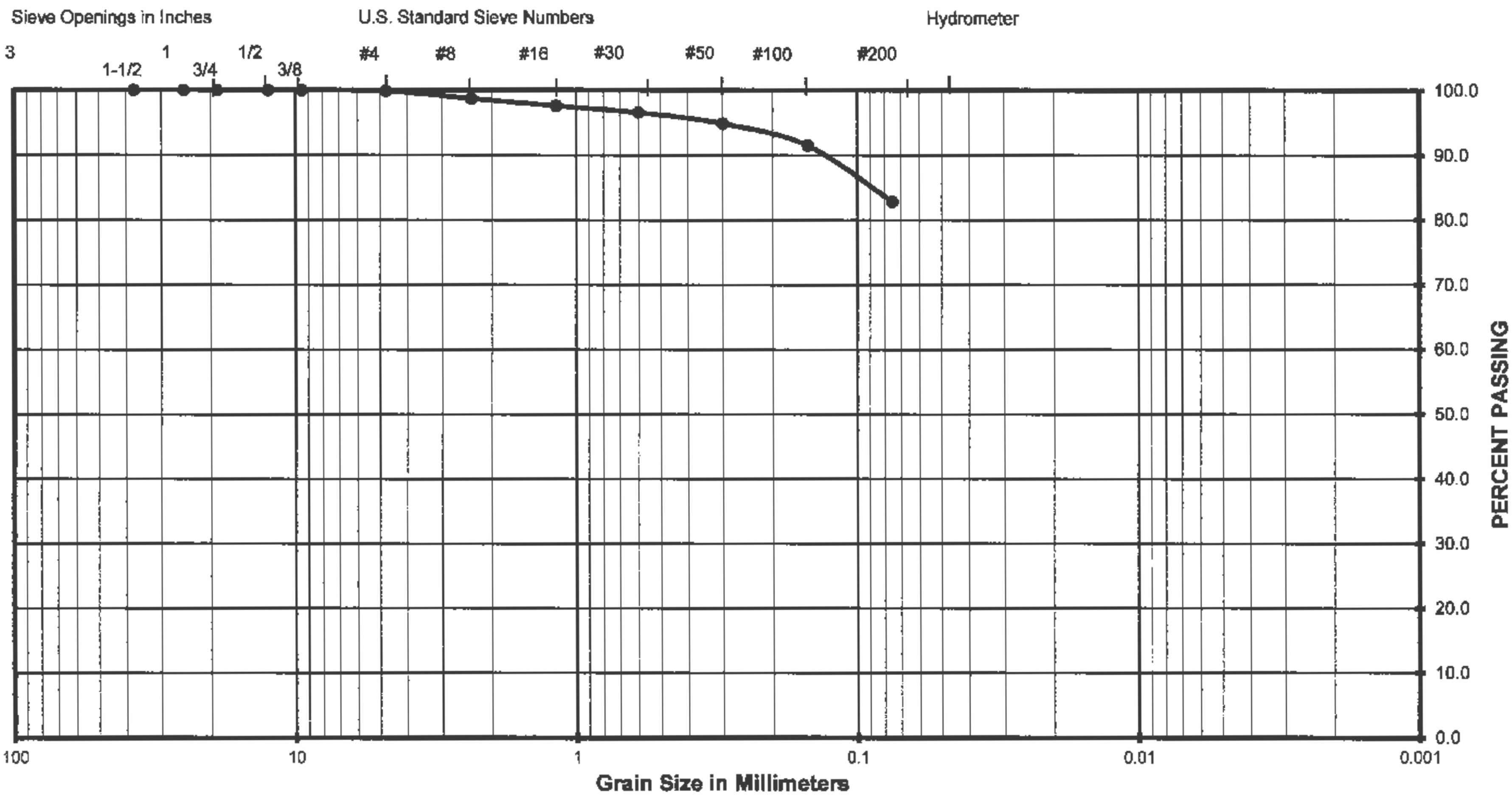
Shear Strength Diagram (Direct Shear)
ASTM D - 3080 / AASHTO T - 236

Project Number	Boring No. & Depth	Soil Type	Date
4215006	B6 @ 5-6'	SC	3/24/2015



Krazan Testing Laboratory

Grain Size Analysis



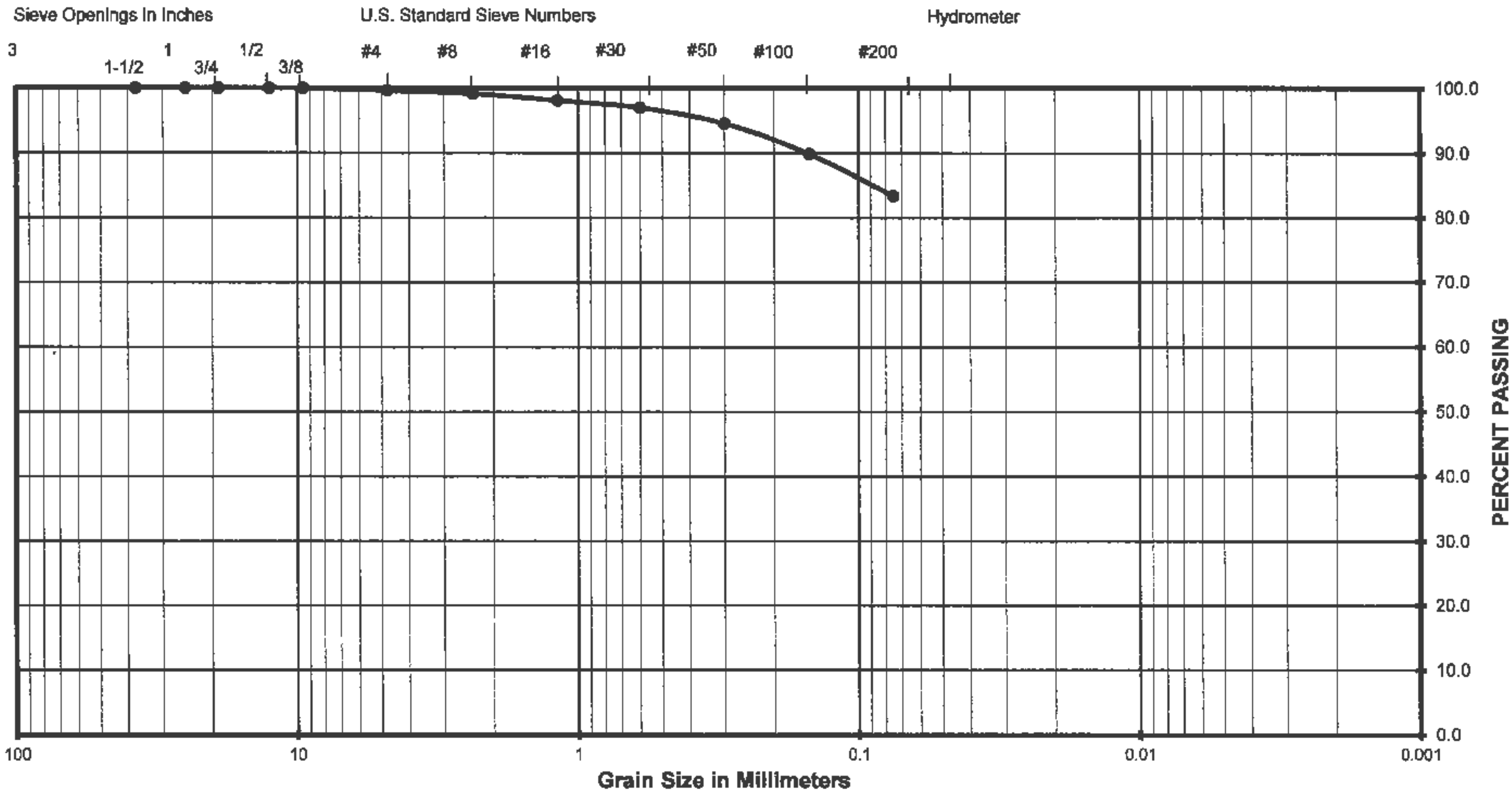
Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

(Unified Soils Classification)

Project Name	Santana Atrium Senior Apartments
Project Number	4215006
Soil Classification	CL
Sample Number	B1 @ 2-3'

Krazan Testing Laboratory

Grain Size Analysis



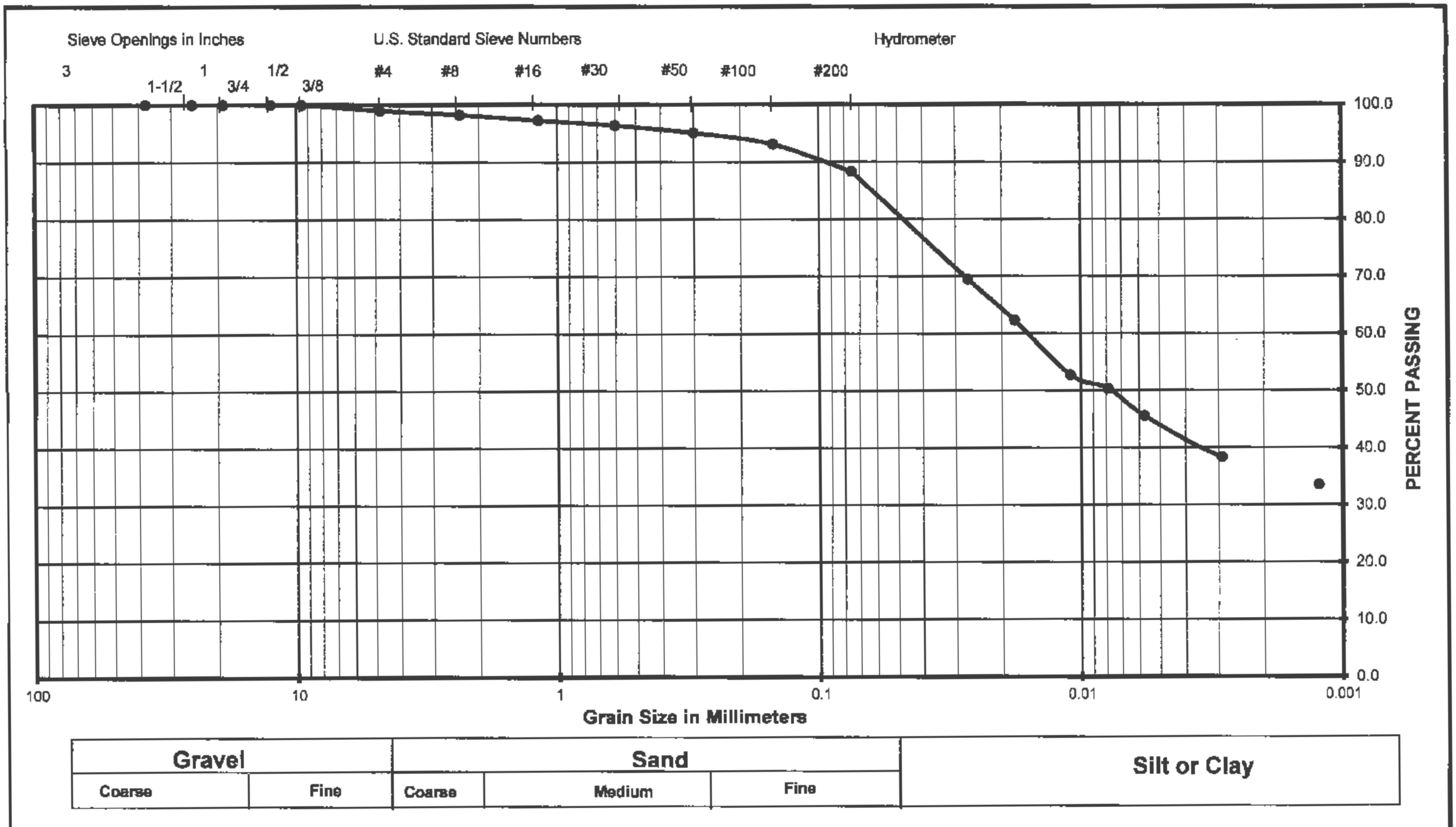
Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

(Unified Soils Classification)

Project Name	Santana Atrium Senior Apartments
Project Number	4215006
Soil Classification	CL
Sample Number	B4 @ 2-3'

Krazan Testing Laboratory

Grain Size Analysis

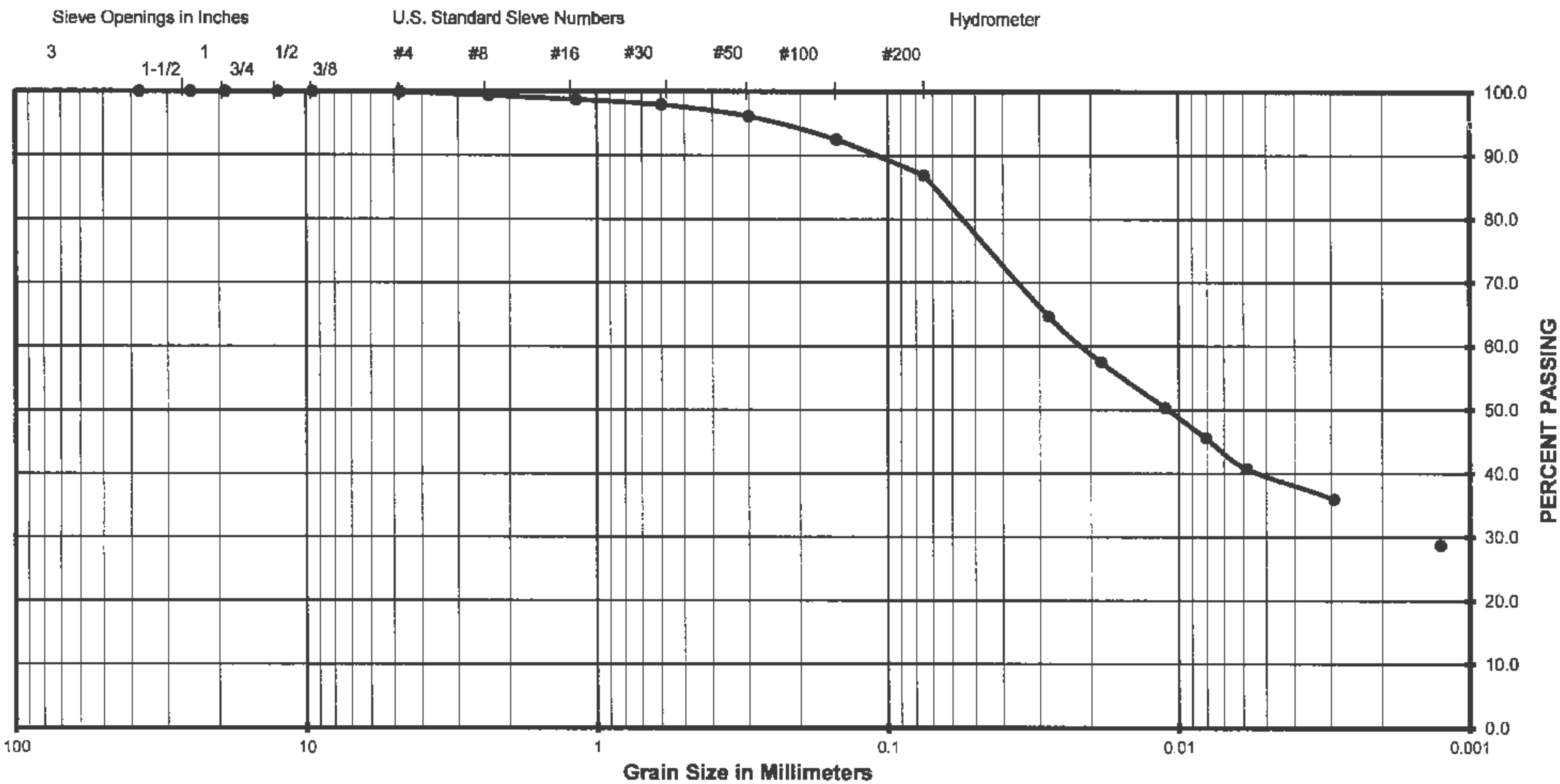


(Unified Soils Classification)

Project Name	Santana Atrium Senior Apartments
Project Number	4215006
Soil Classification	CL
Sample Number	X1 @ 0-1'

Krazan Testing Laboratory

Grain Size Analysis



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

(Unified Soils Classification)

Project Name	Santana Atrium Senior Apartments
Project Number	4215006
Soil Classification	CL
Sample Number	X2 @ 3-5'

Krazan Testing Laboratory

Expansion Index Test

ASTM D - 4829/ UBC Std. 18-2

Project Number	: 4215006
Project Name	: Santana Atrium Senior Apartments
Date	: 3/24/2015
Sample location/ Depth	: 0-1'
Sample Number	: X1
Soil Classification	: CL

Trial #	1	2	3
Weight of Soil & Mold, gms	579.6		
Weight of Mold, gms	183.3		
Weight of Soil, gms	396.3		
Wet Density, Lbs/cu.ft.	119.5		
Weight of Moisture Sample (Wet), gms	300.0		
Weight of Moisture Sample (Dry), gms	271.3		
Moisture Content, %	10.6		
Dry Density, Lbs/cu.ft.	108.1		
Specific Gravity of Soil	2.7		
Degree of Saturation, %	51.1		

Time	Inital	30 min	1 hr	6hrs	12 hrs	24 hrs
Dial Reading	0	--	--	--	--	0.062

Expansion Index $_{measured}$ = 62

Expansion Index = 62

Expansion Potential Table	
Exp. Index	Potential Exp.
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

Krazan Testing Laboratory

Expansion Index Test

ASTM D - 4829/ UBC Std. 18-2

Project Number	: 4215006
Project Name	: Santana Atrium Senior Apartments
Date	: 3/24/2015
Sample location/ Depth	: 3-5'
Sample Number	: X2
Soil Classification	: CL

Trial #	**1**	**2**	**3**
Weight of Soil & Mold, gms	617.3		
Weight of Mold, gms	206.7		
Weight of Soil, gms	410.6		
Wet Density, Lbs/cu.ft.	123.8		
Weight of Moisture Sample (Wet), gms	300.0		
Weight of Moisture Sample (Dry), gms	274.3		
Moisture Content, %	9.4		
Dry Density, Lbs/cu.ft.	113.2		
Specific Gravity of Soil	2.7		
Degree of Saturation, %	51.8		

Time	Inital	30 min	1 hr	6hrs	12 hrs	24 hrs
Dial Reading	0	--	--	--	--	0.053

Expansion Index $_{measured}$ = 53

Expansion Index = 53

Expansion Potential Table	
Exp. Index	Potential Exp.
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

Krazan Testing Laboratory

Plasticity Index of Soils

ASTM D4318/AASHTO T89 T90/CT 204

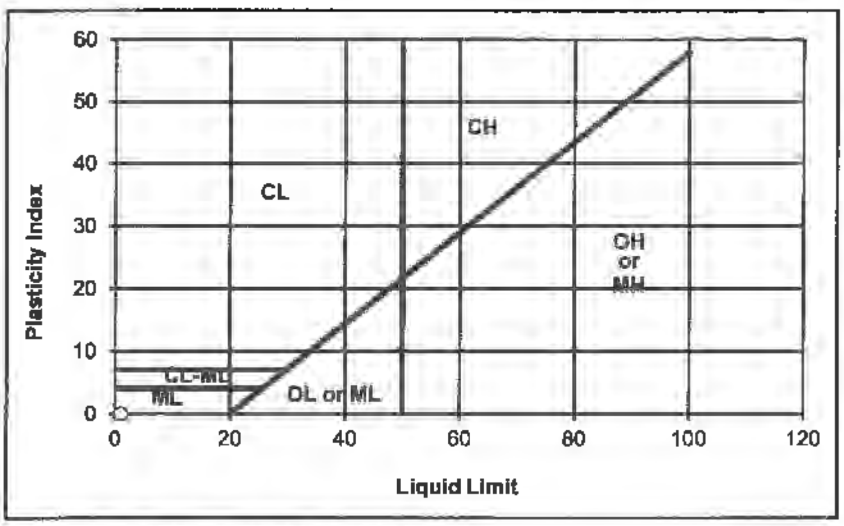
Project: **Santana Atrium Senior Apartments**
Project Number: **4215006**
Date Sampled: 3/10/2015
Sampled By: RA
Sample Number:
Sample Location: B1 @ 20-21'
Sample Description: SM w/ grvl

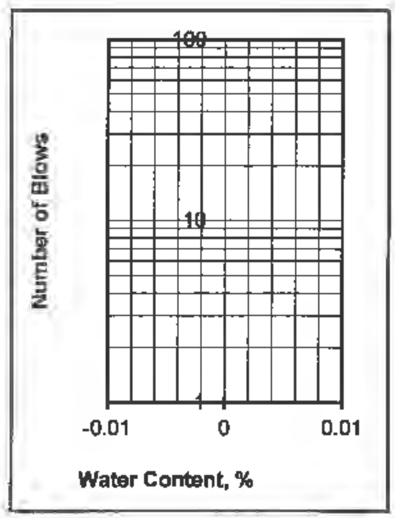
Date Tested: 3/24/2015
Tested By: JD
Verified By: JKG

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)						
Weight of Dry Soil & Tare (g)						
Weight of Tare (g)						
Weight of water (g)						
Weight of Dry Soil (g)						
Water Content (% of dry wt.)						
Number of Blows						

Plastic Limit : N/D **Liquid Limit : N/D**

Plasticity Index : NON-PLASTIC
Unified Soil Classification : NON-PLASTIC **Requirement:**
Approx. % of Material Retained on # 40 Sieve:





Departures from Outlined Procedure:

Unusual Conditions, Other Notes:

Plasticity Index of Soils

ASTM D4318/AASHTO T89 T90/CT 204

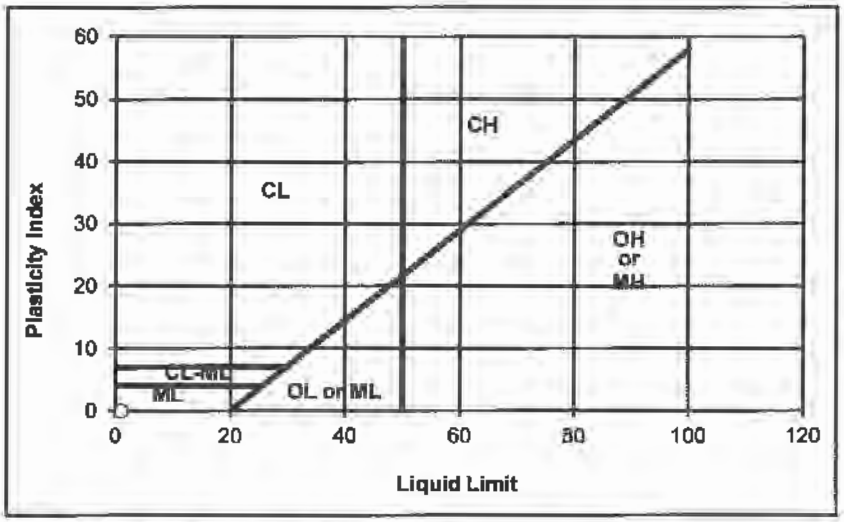
Project: **Santana Atrium Senior Apartments**
Project Number: **4215006**
Date Sampled: 3/10/2015
Sampled By: RA
Sample Number:
Sample Location: B1 @ 25-26'
Sample Description: SM-ML

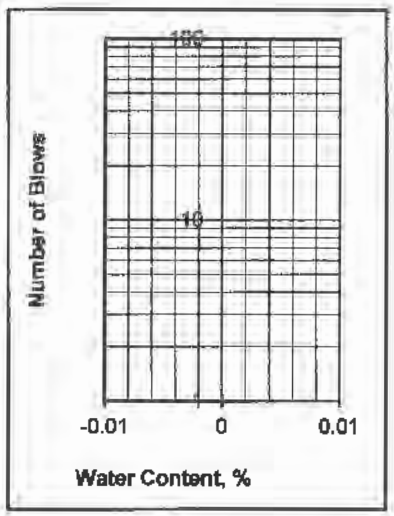
Date Tested: 3/24/2015
Tested By: JD
Verified By: JKG

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)						
Weight of Dry Soil & Tare (g)						
Weight of Tare (g)						
Weight of water (g)						
Weight of Dry Soil (g)						
Water Content (% of dry wt.)						
Number of Blows						

Plastic Limit : N/D **Liquid Limit : N/D**

Plasticity Index : NON-PLASTIC
Unified Soil Classification : NON-PLASTIC **Requirement:**
Approx. % of Material Retained on # 40 Sieve:





Departures from Outlined Procedure:

Unusual Conditions, Other Notes:

Plasticity Index of Soils

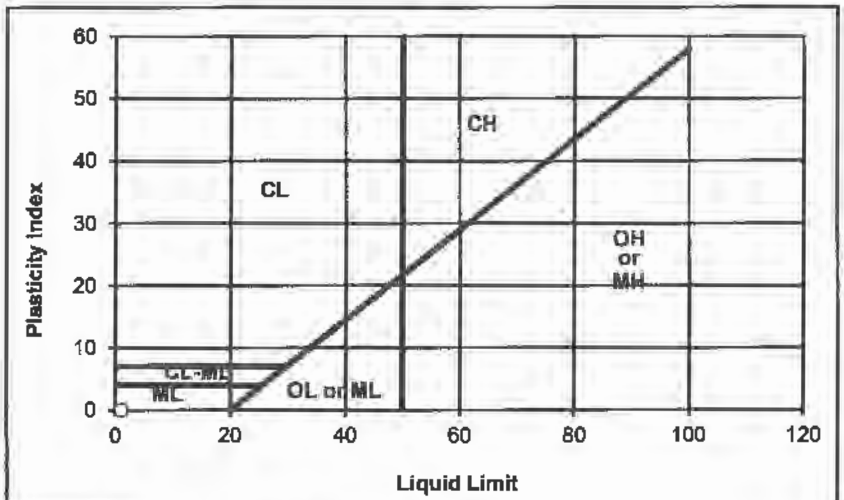
ASTM D4318/AASHTO T89 T90/CT 204

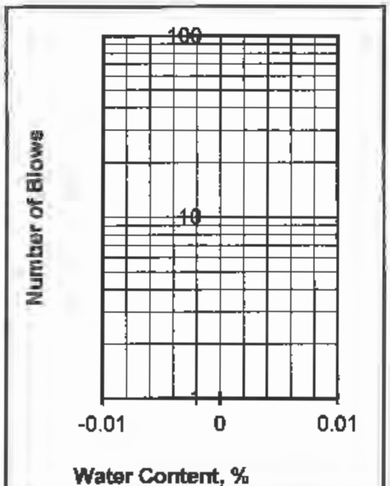
Project: **Santana Atrium Senior Apartments**
Project Number: **4215006**
Date Sampled: 3/10/2015 Date Tested: 3/24/2015
Sampled By: RA Tested By: JD
Sample Number: Verified By: JKG
Sample Location: B1 @ 30-31'
Sample Description: SM w/ grvl

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)						
Weight of Dry Soil & Tare (g)						
Weight of Tare (g)						
Weight of water (g)						
Weight of Dry Soil (g)						
Water Content (% of dry wt.)						
Number of Blows						

Plastic Limit : N/D **Liquid Limit : N/D**

Plasticity Index : NON-PLASTIC
Unified Soil Classification : NON-PLASTIC **Requirement:**
Approx. % of Material Retained on # 40 Sieve:





Departures from Outlined Procedure:

Unusual Conditions, Other Notes:

Plasticity Index of Soils

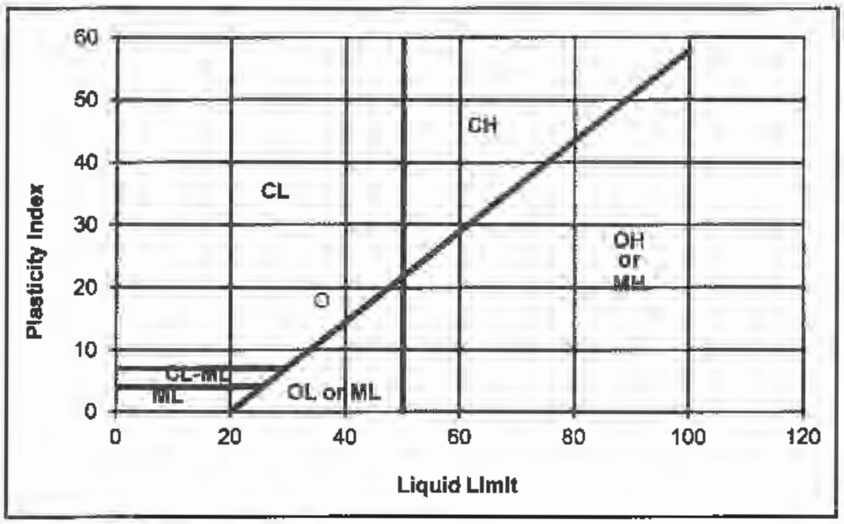
ASTM D4318/AASHTO T89 T90/CT 204

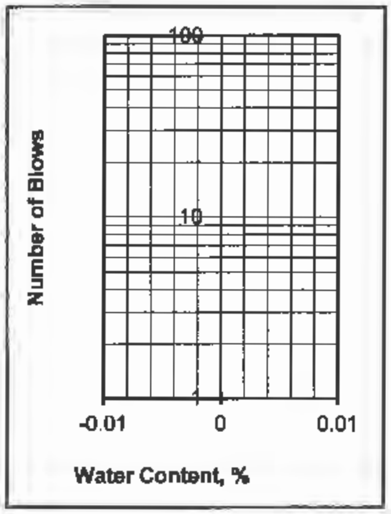
Project: **Santana Atrium Senior Apartments**
Project Number: **4215006**
Date Sampled: 3/10/2015 Date Tested: 3/24/2015
Sampled By: RA Tested By: JD
Sample Number: X1 Verified By: JKG
Sample Location: 0-1'
Sample Description: CL

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)	18.32	26.00		21.75	23.65	
Weight of Dry Soil & Tare (g)	17.65	25.36		19.74	21.09	
Weight of Tare (g)	13.90	21.74		14.05	14.02	
Weight of water (g)	0.67	0.64		2.02	2.56	
Weight of Dry Soil (g)	3.75	3.62		5.69	7.07	
Water Content (% of dry wt.)	17.8%	17.7%		35.5%	36.2%	
Number of Blows				30	21	

Plastic Limit : 18 **Liquid Limit : 36**

Plasticity Index : 18
Unified Soil Classification : CL **Requirement:**
Approx. % of Material Retained on # 40 Sieve:





Departures from Outlined Procedure:

Unusual Conditions, Other Notes:

Plasticity Index of Soils

ASTM D4318/AASHTO T89 T90/CT 204

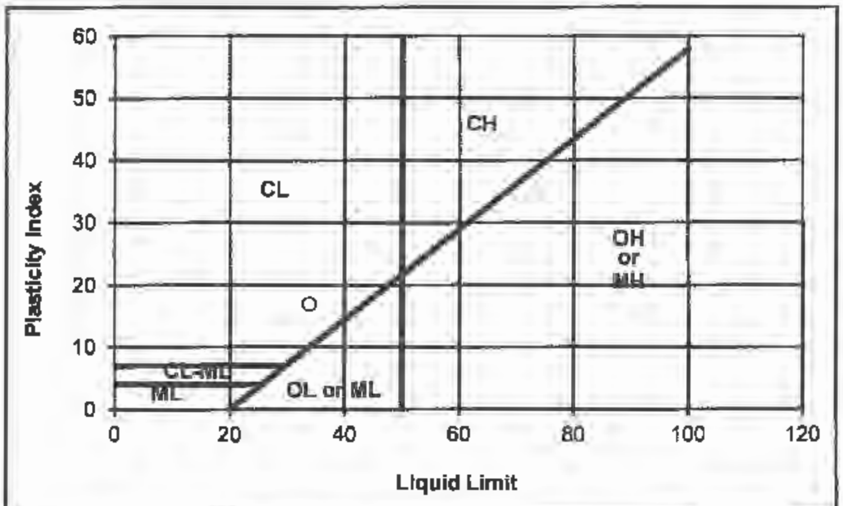
Project: **Santana Atrium Senior Apartments**
Project Number: **4215006**
Date Sampled: 3/10/2015
Sampled By: RA
Sample Number: 3-5'
Sample Location: X2
Sample Description: CL

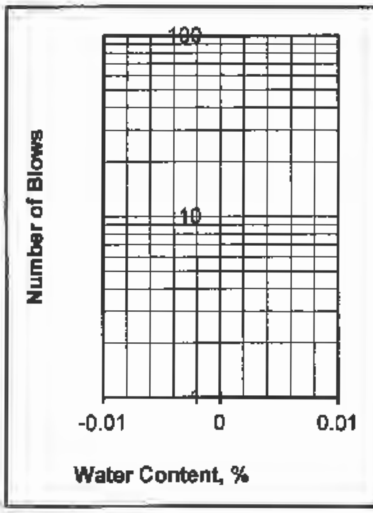
Date Tested: 3/24/2015
Tested By: JD
Verified By: JKG

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)	17.83	18.68		23.53	22.25	
Weight of Dry Soil & Tare (g)	17.23	18.07		21.16	20.20	
Weight of Tare (g)	13.78	14.49		14.23	14.08	
Weight of water (g)	0.60	0.61		2.37	2.05	
Weight of Dry Soil (g)	3.45	3.58		6.93	6.12	
Water Content (% of dry wt.)	17.4%	17.0%		34.2%	33.5%	
Number of Blows				20	31	

Plastic Limit : 17 **Liquid Limit : 34**

Plasticity Index : 17
Unified Soil Classification : CL
Requirement:
Approx. % of Material Retained on # 40 Sieve:





Departures from Outlined Procedure:

Unusual Conditions, Other Notes:

Hydrometer Anaylsis

Project Number : 4215006
Project Name : Santana Atrium Senior Apartments
Date : 3/24/2015
Sample Location : X1 @ 0-1'
Soil Classification : CL

Dry Weight Used	67.1 g
Temperature	20.0 C
Soil Specific Gravity	2.65
Solution Spec. Grav.	1.003
K Value	0.01365
Correction Factor	0.00000

Elapsed Time (min)	Hydro. Reading	Hydro. Corrected	% Passing	Particle Diameter
2	1.032	1.032	69.5	0.0270
5	1.029	1.029	62.3	0.0179
15	1.025	1.025	52.8	0.0110
30	1.024	1.024	50.4	0.0079
60	1.022	1.022	45.6	0.0057
250	1.019	1.019	38.4	0.0029
1440	1.017	1.017	33.6	0.0012

Particle Diameter	Percent Passing
0.005	43.7
0.002	35.8
0	NA

Krazan Testing Laboratory

Hydrometer Anaylsis

Project Number	: 4215006
Project Name	: Santana Atrium Senior Apartments
Date	: 3/24/2015
Sample Location	: X2 @ 3-5'
Soil Classification	: CL

Dry Weight Used	67.1 g
Temperature	20.0 C
Soil Specific Gravity	2.65
Solution Spec. Grav.	1.003
K Value	0.01365
Correction Factor	0.00000

Elapsed Time (min)	Hydro. Reading	Hydro. Corrected	% Passing	Particle Diameter
2	1.03	1.03	64.7	0.0280
5	1.027	1.027	57.5	0.0185
15	1.024	1.024	50.4	0.0111
30	1.022	1.022	45.6	0.0081
60	1.02	1.02	40.8	0.0058
250	1.018	1.018	36.0	0.0029
1440	1.015	1.015	28.8	0.0013

Particle Diameter	Percent Passing
0.005	39.4
0.002	32.0
0	NA

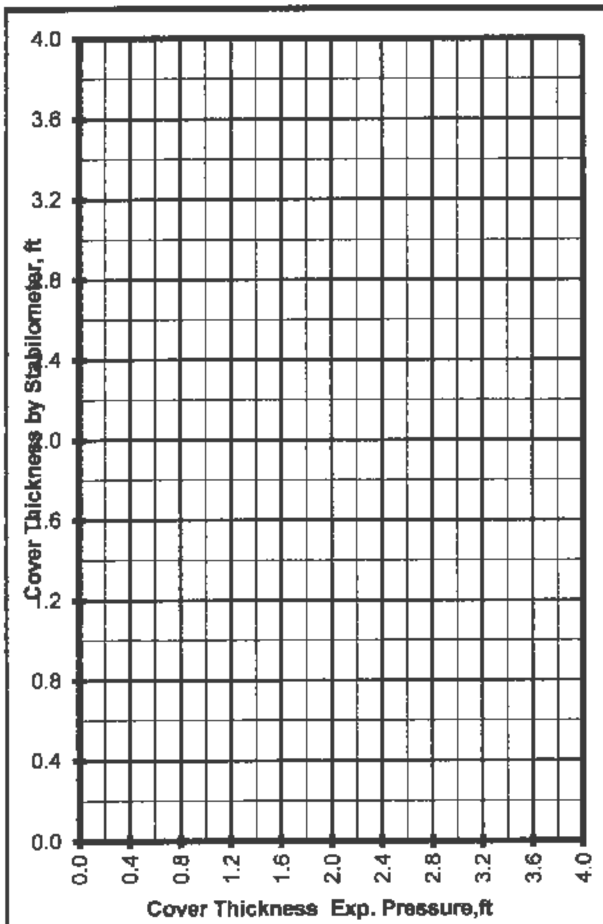
Krazan Testing Laboratory

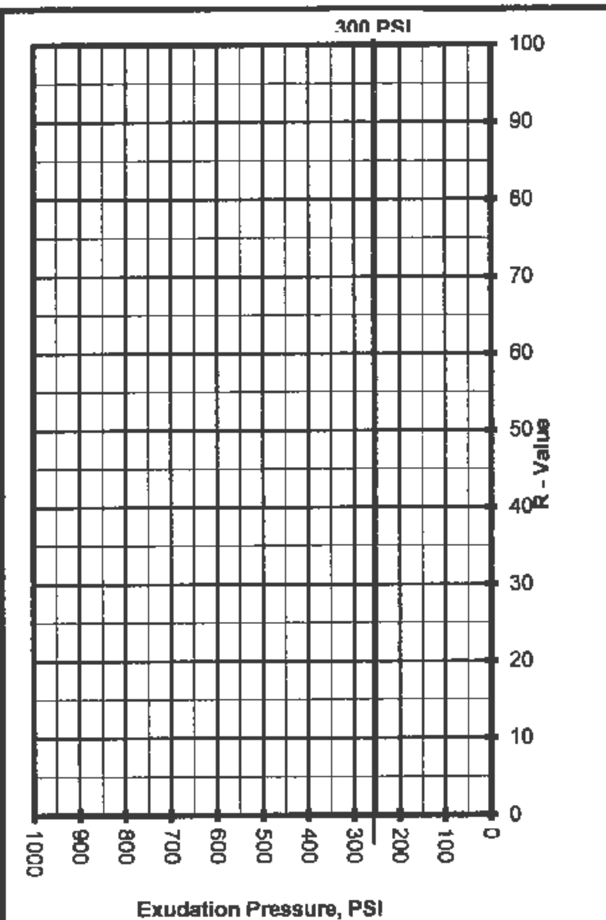
R - VALUE TEST
ASTM D - 2844 / CAL 301

Project Number	:	4215006
Project Name	:	Santana Atrium Senior Apartments
Date	:	3/17/2015
Sample Location/Curve Number	:	RV#1
Soil Classification	:	CL

TEST	A	B	C
Percent Moisture @ Compaction, %			
Dry Density, lbm/cu.ft.		R - Value less than 5	
Exudation Pressure, psi		Sample Exuded from bottom of Mold	
Expansion Pressure, (Dial Reading)		During test	
Expansion Pressure, psf			
Resistance Value R			

R - Value at 300 PSI Exudation Pressure	< 5
R - Value by Expansion Pressure	



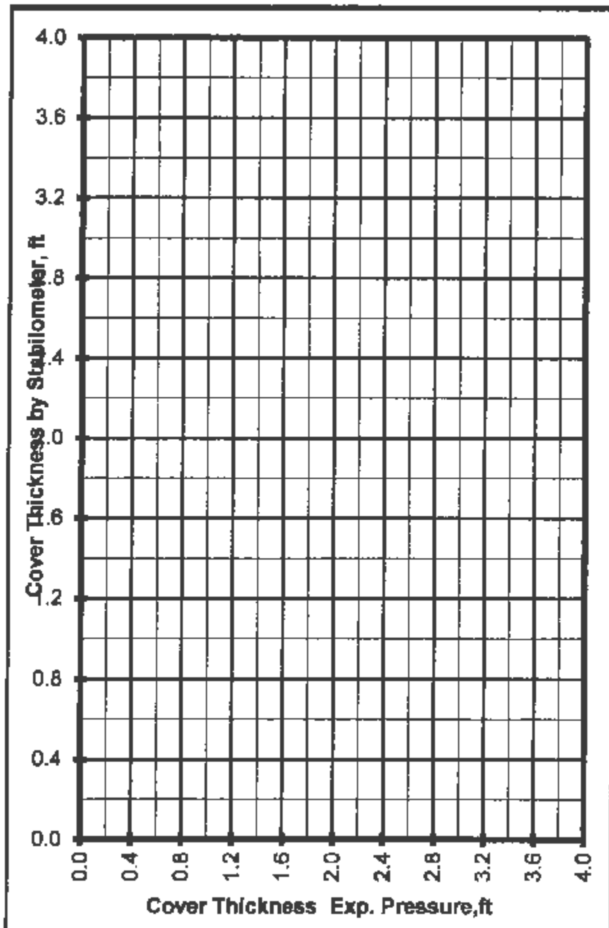


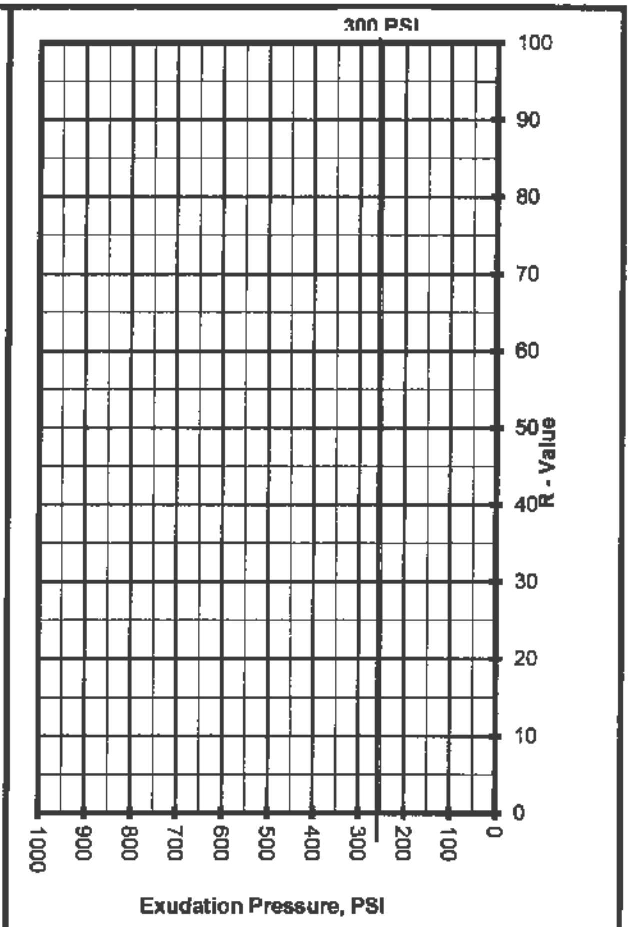
R - VALUE TEST
ASTM D - 2844 / CAL 301

Project Number	:	4215006
Project Name	:	Santana Atrium Senior Apartments
Date	:	3/17/2015
Sample Location/Curve Number	:	RV#2
Soil Classification	:	CL

TEST	A	B	C
Percent Moisture @ Compaction, %			
Dry Density, lbm/cu.ft.	R - Value less than 5		
Exudation Pressure, psi	Sample Exuded from bottom of Mold		
Expansion Pressure, (Dial Reading)	During test		
Expansion Pressure, psf			
Resistance Value R			

R - Value at 300 PSI Exudation Pressure	< 5
R - Value by Expansion Pressure	





APPENDIX B

EARTHWORK SPECIFICATIONS

GENERAL

When the text of the report conflicts with the general specifications in this appendix, the recommendations in the report have precedence.

SCOPE OF WORK: These specifications and applicable plans pertain to and include all earthwork associated with the site rough grading, including but not limited to the furnishing of all labor, tools, and equipment necessary for site clearing and grubbing, stripping, preparation of foundation materials for receiving fill, excavation, processing, placement and compaction of fill and backfill materials to the lines and grades shown on the project grading plans, and disposal of excess materials.

PERFORMANCE: The Contractor shall be responsible for the satisfactory completion of all earthwork in accordance with the project plans and specifications. This work shall be inspected and tested by a representative of Krazan and Associates, Inc., hereinafter known as the Soils Engineer and/or Testing Agency. Attainment of design grades when achieved shall be certified by the project Civil Engineer. Both the Soils Engineer and the Civil Engineer are the Owner's representatives. If the Contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary readjustments until all work is deemed satisfactory as determined by both the Soils Engineer and the Civil Engineer. No deviation from these specifications shall be made except upon written approval of the Soils Engineer, Civil Engineer or project Architect.

No earthwork shall be performed without the physical presence or approval of the Soils Engineer. The Contractor shall notify the Soils Engineer at least 2 working days prior to the commencement of any aspect of the site earthwork.

The Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of this project, including safety of all persons and property; that this requirement shall apply continuously and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold the Owner and the Engineers harmless from any and all liability, real or alleged, in connection with the performance of work on this project, except for liability arising from the sole negligence of the Owner or the Engineers.

TECHNICAL REQUIREMENTS: All compacted materials shall be densified to a density not less than 90 percent relative compaction based on ASTM Test Method D1557 or CAL-216, as specified in the technical portion of the Soil Engineer's report. The location and frequency of field density tests shall be as determined by the Soils Engineer. The results of these tests and compliance with these specifications shall be the basis upon which satisfactory completion of work will be judged by the Soils Engineer.

SOILS AND FOUNDATION CONDITIONS: The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the contents of the data presented in the soil report.

The Contractor shall make his own interpretation of the data contained in said report, and the Contractor shall not be relieved of liability under the Contract documents for any loss sustained as a result of any variance between conditions indicated by or deduced from said report and the actual conditions encountered during the progress of the work.

DUST CONTROL: The work includes dust control as required for the alleviation or prevention of any dust nuisance on or about the site or the borrow area, or off-site if caused by the Contractor's operation either during the performance of the earthwork or resulting from the conditions in which the Contractor leaves the site. The Contractor shall assume all liability, including court costs of codefendants, for all claims related to dust or windblown materials attributable to his work.

SITE PREPARATION

Site preparation shall consist of site clearing and grubbing and the preparations of foundation materials for receiving fill.

CLEARING AND GRUBBING: The Contractor shall accept the site in this present condition and shall demolish and/or remove from the area of designated project earthwork all structures, both surface and subsurface, trees, brush, roots, debris, organic matter, and all other matter determined by the Soils Engineer to be deleterious or otherwise unsuitable. Such materials shall become the property of the Contractor and shall be removed from the site.

Tree root systems in proposed building areas should be removed to a minimum depth of 3 feet and to such an extent which would permit removal of all roots larger than 1 inch. Tree roots removed in parking areas may be limited to the upper 1½ feet of the ground surface. Backfill of tree root excavations should not be permitted until all exposed surfaces have been inspected and the Soils Engineer is present for the proper control of backfill placement and compaction. Burning in areas which are to receive fill materials shall not be permitted.

SUBGRADE PREPARATION: Surfaces to receive Engineered Fill, building or slab loads shall be prepared as outlined above, excavated/scarified to a depth of 12 inches, moisture-conditioned as necessary, and compacted to 90 percent relative compaction.

Loose soil areas, areas of uncertified fill, and/or areas of disturbed soils shall be moisture-conditioned as necessary and recompacted to 90 percent relative compaction. All ruts, hummocks, or other uneven surface features shall be removed by surface grading prior to placement of any fill materials. All areas which are to receive fill materials shall be approved by the Soils Engineer prior to the placement of any of the fill material.

EXCAVATION: All excavation shall be accomplished to the tolerance normally defined by the Civil Engineer as shown on the project grading plans. All over-excavation below the grades specified shall be backfilled at the Contractor's expense and shall be compacted in accordance with the applicable technical requirements.

FILL AND BACKFILL MATERIAL: No material shall be moved or compacted without the presence of the Soils Engineer. Material from the required site excavation may be utilized for construction site fills provided prior approval is given by the Soils Engineer. All materials utilized for constructing site fills shall be free from vegetation or other deleterious matter as determined by the Soils Engineer.

PLACEMENT, SPREADING AND COMPACTION: The placement and spreading of approved fill materials and the processing and compaction of approved fill and native materials shall be the responsibility of the Contractor. However, compaction of fill materials by flooding, ponding, or jetting shall not be permitted unless specifically approved by local code, as well as the Soils Engineer.

Both cut and fill areas shall be surface-compacted to the satisfaction of the Soils Engineer prior to final acceptance.

SEASONAL LIMITS: No fill material shall be placed, spread, or rolled while it is frozen or thawing or during unfavorable wet weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until the Soils Engineer indicates that the moisture content and density of previously placed fill are as specified.

APPENDIX C

PAVEMENT SPECIFICATIONS

1. DEFINITIONS - The term "pavement" shall include asphaltic concrete surfacing, untreated aggregate base, and aggregate subbase. The term "subgrade" is that portion of the area on which surfacing, base, or subbase is to be placed.

The term "Standard Specifications": hereinafter referred to is the 2010 Standard Specifications of the State of California, Department of Transportation, and the "Materials Manual" is the Materials Manual of Testing and Control Procedures, State of California, Department of Public Works, Division of Highways. The term "relative compaction" refers to the field density expressed as a percentage of the maximum laboratory density as defined in the applicable tests outlined in the Materials Manual.

2. SCOPE OF WORK - This portion of the work shall include all labor, materials, tools, and equipment necessary for, and reasonably incidental to the completion of the pavement shown on the plans and as herein specified, except work specifically noted as "Work Not Included."

3. PREPARATION OF THE SUBGRADE - The Contractor shall prepare the surface of the various subgrades receiving subsequent pavement courses to the lines, grades, and dimensions given on the plans. The upper 12 inches of the soil subgrade beneath the pavement section shall be compacted to a minimum relative compaction of 90 percent. The finished subgrades shall be tested and approved by the Soils Engineer prior to the placement of additional pavement courses.

4. UNTREATED AGGREGATE BASE - The aggregate base material shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate base material shall conform to the requirements of Section 26 of the Standard Specifications for Class 2 material, 1½ inches maximum size. The aggregate base material shall be spread and compacted in accordance with Section 26 of the Standard Specifications. The aggregate base material shall be spread in layers not exceeding 6 inches and each layer of aggregate material course shall be tested and approved by the Soils Engineer prior to the placement of successive layers. The aggregate base material shall be compacted to a minimum relative compaction of 95 percent.

5. AGGREGATE SUBBASE - The aggregate subbase shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate subbase material shall conform to the requirements of Section 25 of the Standard Specifications for Class 2 material. The aggregate subbase material shall be compacted to a minimum relative compaction of 95 percent, and it shall be spread and compacted in accordance with Section 25 of the Standard Specifications. Each layer of aggregate subbase shall be tested and approved by the Soils Engineer prior to the placement of successive layers.

6. ASPHALTIC CONCRETE SURFACING - Asphaltic concrete surfacing shall consist of a mixture of mineral aggregate and paving grade asphalt, mixed at a central mixing plant and spread and compacted on a prepared base in conformity with the lines, grades and dimensions shown on the plans. The viscosity grade of the asphalt shall be PG 64-10. The mineral aggregate shall be Type B, ½ inch maximum size, medium grading and shall conform to the requirements set forth in Section 39 of the 2010 Standard Specifications. The drying, proportioning and mixing of the materials shall conform to Section 39 of the 2010 Standard Specifications, as well.

The prime coat, spreading and compacting equipment and spreading and compacting mixture shall conform to the applicable chapters of Section 39 of the 2010 Standard Specifications, with the exception that no surface course shall be placed when the atmospheric temperature is below 50° F. The surfacing shall be rolled with a combination of steel wheel and pneumatic rollers, as described in Section 39-6 of the 2010 Standard Specifications. The surface course shall be placed with an approved self-propelled mechanical spreading and finishing machine.

7. FOG SEAL COAT - The fog seal (mixing type asphaltic emulsion) shall conform to and be applied in accordance with the requirements of Section 37.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Santa Clara Area, California, Western Part

100 Winchester Blvd

June 17, 2015

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:798 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Santa Clara Area, California, Western Part
Survey Area Data: Version 3, Sep 18, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 7, 2013—Nov 3, 2013

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Santa Clara Area, California, Western Part (CA641)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
140	Urban land-Flaskan complex, 0 to 2 percent slopes	0.4	22.8%
165	Urbanland-Campbell complex, 0 to 2 percent slopes, protected	1.5	77.2%
Totals for Area of Interest		**1.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Santa Clara Area, California, Western Part

140—Urban land-Flaskan complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 1nszx
Elevation: 20 to 660 feet
Mean annual precipitation: 14 to 24 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 275 to 325 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 70 percent
Flaskan and similar soils: 20 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Disturbed and human transported material

Description of Flaskan

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from metamorphic and sedimentary rock and/or alluvium derived from metavolcanics

Typical profile

Ap - 0 to 2 inches: sandy loam
ABt - 2 to 7 inches: sandy clay loam
Bt1 - 7 to 17 inches: gravelly sandy clay loam
Bt2 - 17 to 31 inches: gravelly sandy clay loam
C - 31 to 59 inches: very gravelly sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: C

Minor Components

Pachic haploxerolls, loamy-skeletal

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Landelspark

Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Botella

Percent of map unit: 2 percent
Landform: Alluvial fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Stevenscreek

Percent of map unit: 1 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

165—Urbanland-Campbell complex, 0 to 2 percent slopes, protected

Map Unit Setting

National map unit symbol: 1qsvl
Elevation: 0 to 240 feet
Mean annual precipitation: 14 to 24 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 275 to 325 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 70 percent
Campbell, protected, and similar soils: 20 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Disturbed and human-transported material

Description of Campbell, Protected

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from metamorphic and sedimentary rock and/or alluvium derived from metavolcanics

Typical profile

Ap - 0 to 10 inches: silt loam
A1 - 10 to 24 inches: silt loam
A2 - 24 to 31 inches: silty clay loam
A3 - 31 to 38 inches: silty clay loam
2A - 38 to 51 inches: silty clay loam
2Bw1 - 51 to 71 inches: silty clay
2Bw2 - 71 to 79 inches: silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to slightly saline (1.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: C

Minor Components

Newpark

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Clear lake

Percent of map unit: 5 percent
Landform: Basin floors
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Physical Soil Properties (100 Winchester Blvd)

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Physical Soil Properties–Santa Clara Area, California, Western Part														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
140—Urban land-Flaskan complex, 0 to 2 percent slopes														
Urban land	—	—	—	—	—	—	—	—	—					
Flaskan	0-2	-62-	-19-	16-19- 30	1.35-1.40-1.45	1.40-2.00-4.00	0.10-0.14-0.18	0.0- 3.0- 6.0	1.0- 2.0-3.0	.24	.24	4	3	86
	2-7	-60-	-18-	18-22- 35	1.35-1.40-1.45	1.40-3.00-4.00	0.14-0.15-0.18	0.0- 3.0- 6.0	1.0- 1.5-3.0	.24	.24			
	7-17	-57-	-18-	18-25- 35	1.35-1.40-1.45	1.40-3.00-4.00	0.11-0.11-0.14	0.0- 3.0- 6.0	0.8- 1.4-1.8	.15	.24			
	17-31	-60-	-18-	18-22- 35	1.35-1.40-1.45	1.40-3.00-4.00	0.10-0.11-0.13	0.0- 3.0- 6.0	0.4- 0.7-1.0	.15	.28			
	31-59	-64-	-19-	14-17- 35	1.35-1.40-1.45	1.40-3.00-4.00	0.05-0.06-0.09	0.0- 3.0- 6.0	0.3- 0.4-0.5	.05	.24			
Pachic haploxerolls, loamy-skeletal	0-2	-65-	-19-	10-16- 20	1.40-1.45-1.50	14.00-20.00-42.00	0.09-0.10-0.11	0.0- 1.5- 3.0	1.0- 2.0-3.0	.15	.20	4	5	56
	2-14	-61-	-19-	10-20- 20	1.40-1.45-1.50	4.00-10.00-14.00	0.08-0.10-0.13	0.0- 1.5- 3.0	1.0- 1.5-3.0	.10	.24			
	14-31	-65-	-17-	10-18- 20	1.40-1.45-1.50	4.00-10.00-14.00	0.08-0.10-0.13	0.0- 1.5- 3.0	0.8- 1.4-1.8	.05	.20			
	31-47	-84-	-11-	5- 5- 15	1.60-1.65-1.70	14.00-30.00-42.00	0.04-0.05-0.06	0.0- 1.5- 3.0	0.3- 0.4-0.5	.02	.17			

Physical Soil Properties–Santa Clara Area, California, Western Part														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
	47-59	-84-	-11-	5- 5- 15	1.60-1.65-1.70	14.00-30.00-42.00	0.04-0.05-0.06	0.0- 1.5- 3.0	0.3- 0.4-0.5	.05	.17			
Botella	0-7	-61-	-19-	15-20- 28	1.40-1.45-1.55	1.40-20.00-42.00	0.10-0.15-0.18	1.0- 2.0- 3.0	1.0- 2.0-3.0	.24	.24	5	5	56
	7-14	-59-	-18-	20-23- 35	1.35-1.45-1.50	1.40-2.00-4.00	0.17-0.19-0.21	3.0- 3.0- 6.0	1.0- 1.5-2.0	.24	.24			
	14-21	-35-	-33-	27-32- 35	1.35-1.45-1.50	1.40-1.40-4.00	0.15-0.16-0.18	3.0- 3.0- 6.0	0.8- 1.0-1.5	.32	.32			
	21-34	-33-	-31-	27-36- 38	1.35-1.45-1.50	1.40-1.40-4.00	0.15-0.16-0.18	3.0- 3.0- 6.0	0.5- 0.8-1.0	.28	.28			
	34-55	-33-	-32-	27-35- 35	1.35-1.45-1.50	1.40-1.40-4.00	0.15-0.16-0.18	3.0- 3.0- 6.0	0.5- 0.8-1.0	.28	.28			
	55-68	-33-	-32-	27-35- 35	1.35-1.45-1.50	1.40-1.40-4.00	0.15-0.16-0.18	3.0- 3.0- 6.0	0.3- 0.5-0.8	.28	.28			
Landelspark	0-1	-35-	-50-	0-15- 25	0.10-0.20-0.30	42.00-373.00-705.00	0.30-0.45-0.60	—	65.0-75.0-95.0			4	3	86
	1-4	-67-	-15-	15-18- 25	1.45-1.50-1.55	14.00-20.00-42.00	0.10-0.12-0.13	0.0- 1.5- 3.0	2.0- 3.0-4.0	.20	.20			
	4-10	-60-	-18-	15-22- 25	1.40-1.45-1.50	1.40-3.00-4.00	0.17-0.20-0.21	0.0- 1.5- 3.0	1.5- 2.0-3.0	.24	.24			
	10-19	-59-	-18-	15-23- 25	1.40-1.45-1.50	1.40-3.00-4.00	0.17-0.20-0.21	0.0- 1.5- 3.0	1.0- 1.5-2.0	.24	.24			
	19-23	-97-	- 2-	2- 2- 10	1.60-1.65-1.70	42.00-100.00-141.00	0.05-0.07-0.08	0.0- 0.0- 0.0	0.2- 0.3-0.4	.02	.05			
	23-35	-18-	-55-	25-27- 30	1.35-1.40-1.45	1.40-3.00-4.00	0.17-0.20-0.21	0.0- 1.5- 3.0	0.5- 0.8-1.0	.49	.49			
	35-55	-34-	-37-	25-29- 30	1.35-1.40-1.45	1.40-3.00-4.00	0.17-0.20-0.21	0.0- 1.5- 3.0	0.3- 0.4-0.5	.32	.32			

Physical Soil Properties–Santa Clara Area, California, Western Part														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
	55-79	-57-	-18-	10-25- 25	1.40-1.45-1.50	1.40-3.00-4.00	0.14-0.17-0.18	0.0- 1.5- 3.0	0.2- 0.3-0.5	.24	.24			
Stevenscreek	0-2	-64-	-19-	12-17- 28	1.45-1.50-1.55	1.40-4.00-14.00	0.14-0.16-0.18	3.0- 6.0- 9.0	1.5- 2.0-3.0	.17	.17	5	3	86
	2-9	-21-	-55-	16-25- 28	1.45-1.50-1.55	1.40-2.00-4.00	0.14-0.17-0.21	3.0- 6.0- 9.0	1.5- 2.0-3.0	.43	.43			
	9-18	-18-	-50-	27-32- 40	1.45-1.50-1.55	1.40-2.00-4.00	0.14-0.17-0.21	3.0- 6.0- 9.0	1.3- 1.4-3.0	.37	.37			
	18-27	-17-	-49-	27-34- 40	1.45-1.50-1.55	1.40-2.00-4.00	0.14-0.17-0.21	3.0- 6.0- 9.0	0.5- 0.7-1.5	.37	.37			
	27-39	-34-	-32-	27-34- 40	1.45-1.50-1.55	1.40-2.00-4.00	0.14-0.17-0.21	3.0- 6.0- 9.0	0.3- 0.4-0.8	.28	.28			
	39-61	-54-	-14-	25-32- 40	1.45-1.50-1.55	1.40-2.00-4.00	0.14-0.17-0.21	3.0- 6.0- 9.0	0.2- 0.3-0.5	.20	.20			
	61-70	-55-	-17-	20-28- 35	1.45-1.50-1.55	1.40-2.00-4.00	0.14-0.17-0.21	3.0- 6.0- 9.0	0.1- 0.2-0.3	.24	.24			

Physical Soil Properties–Santa Clara Area, California, Western Part															
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
165—Urbanland-Campbell complex, 0 to 2 percent slopes, protected														
Urban land	—	—	—	—	—	—	—	—	—					
Campbell, protected	0-10	- 7-	-69-	20-24- 35	1.35-1.40-1.45	1.40-5.00-14.00	0.15-0.17-0.21	3.0- 4.5- 6.0	2.0- 3.4-4.0	.37	.37	5	6	48
	10-24	- 7-	-67-	25-26- 35	1.35-1.40-1.45	1.40-5.00-14.00	0.15-0.17-0.21	3.0- 4.5- 6.0	1.0- 1.4-2.0	.49	.49			
	24-31	- 7-	-65-	25-28- 35	1.35-1.40-1.45	1.40-3.00-14.00	0.15-0.18-0.21	6.0- 7.5- 9.0	0.5- 0.7-1.0	.49	.49			
	31-38	- 7-	-64-	25-29- 35	1.35-1.40-1.45	1.40-3.00-14.00	0.15-0.18-0.21	6.0- 7.5- 9.0	0.3- 0.4-0.8	.49	.49			
	38-51	- 7-	-64-	27-29- 35	1.35-1.40-1.45	1.40-3.00-14.00	0.15-0.18-0.21	6.0- 7.5- 9.0	0.3- 0.4-0.5	.49	.49			
	51-71	- 8-	-52-	35-40- 50	1.30-1.35-1.40	0.42-1.00-1.40	0.14-0.16-0.17	9.0-10.5-12.0	0.2- 0.3-0.4	.37	.37			
	71-79	- 7-	-48-	35-45- 50	1.30-1.35-1.40	0.42-1.00-1.40	0.14-0.16-0.17	9.0-10.5-12.0	0.1- 0.2-0.3	.32	.32			
Clear lake	0-9	- 8-	-47-	35-45- 50	1.35-1.45-1.55	0.42-2.00-4.00	0.14-0.16-0.18	9.0-10.5-12.0	1.0- 1.5-2.0	.28	.28	5	4	86
	9-14	- 8-	-47-	35-45- 50	1.35-1.45-1.55	0.42-2.00-4.00	0.14-0.16-0.18	9.0-10.5-12.0	1.0- 1.5-2.0	.28	.28			
	14-32	- 8-	-45-	35-47- 50	1.35-1.45-1.55	0.42-2.00-4.00	0.14-0.16-0.18	9.0-10.5-12.0	1.0- 1.5-2.0	.28	.28			
	32-50	- 8-	-44-	35-48- 50	1.35-1.45-1.55	0.42-2.00-4.00	0.14-0.16-0.18	9.0-10.5-12.0	0.5- 0.8-1.0	.28	.28			

Physical Soil Properties–Santa Clara Area, California, Western Part														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
	50-66	- 9-	-51-	30-40- 45	1.25-1.35-1.45	0.42-2.00-4.00	0.14-0.16-0.18	9.0-10.5-12.0	0.3- 0.5-0.8	.32	.32			
Newpark	0-8	- 7-	-63-	25-30- 35	1.35-1.40-1.45	1.40-2.00-4.00	0.17-0.19-0.21	3.0- 4.5- 6.0	1.0- 2.0-4.0	.43	.43	5	6	48
	8-18	- 6-	-62-	25-32- 35	1.35-1.40-1.45	1.40-2.00-4.00	0.17-0.19-0.21	3.0- 4.5- 6.0	1.0- 1.4-2.0	.43	.43			
	18-27	- 6-	-62-	25-32- 35	1.35-1.40-1.45	1.40-2.00-4.00	0.17-0.19-0.21	3.0- 4.5- 6.0	0.5- 0.7-1.0	.43	.43			
	27-36	- 7-	-65-	27-28- 35	1.35-1.40-1.45	1.40-2.00-4.00	0.17-0.19-0.21	3.0- 4.5- 6.0	0.3- 0.4-0.8	.49	.49			
	36-52	- 7-	-65-	27-28- 35	1.35-1.40-1.45	1.40-2.00-4.00	0.17-0.19-0.21	3.0- 4.5- 6.0	0.3- 0.4-0.8	.49	.49			
	52-63	-69-	-16-	15-15- 30	1.40-1.45-1.55	1.40-10.00-14.00	0.13-0.17-0.21	3.0- 4.5- 6.0	0.2- 0.3-0.5	.28	.28			
	63-79	-68-	-16-	15-16- 30	1.40-1.45-1.50	1.40-10.00-14.00	0.13-0.17-0.21	3.0- 4.5- 6.0	0.2- 0.3-0.5	.28	.28			

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf